

10-57 Radio

HINTS & KINKS

for the Radio Amateur

*. . . A Symposium of
the Selected Practical
Money-Saving Ideas
of 189 Experimenters*

Price
50 cents



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FOREWORD

THE radio world says that we radio amateurs are ingenious experimenters. Every once in so often one of us, confronted with some peculiar problem, commences to bristle with the high voltage of a grand idea, and straightway a new method of doing something is born. It is a very significant fact, too, that in general terms the best of us are those that have the least with which to do. Pressed by the imperative necessity of doing something without the usual apparatus or the desired tools, sheer resourcefulness invents a new way. It may be just a new way to make a hole or a new scheme for adapting a three-band antenna system to an American back yard or an idea for making a piece of old gear do duty its manufacturer never contemplated. Whatever it is, it is new and it is useful to all the rest of us because we all have "junk-boxes," problems, and insufficient apparatus and money. We want to hear about it too.

This booklet is a compilation of the best of these good ideas, contributed by the originators through our common organization, the American Radio Relay League. Most of the material has appeared in *QST*. There it has frequently been lost to sight, shadowed by some "big article" or forgotten in the excitement of some major development. It has deserved a better fate than that, for much of it is the garnered gold of amateur experimentation. Again, too, there is the annoying business of vaguely remembering a *QST* squib on exactly the problem that confronts one but being unable to find it when it is most needed. The present publication restores this hidden gold to circulation, arranges it in a fashion to permit ready reference, and provides an index which is really a guide to the best "experimental expedients" of the last several years. It should prove — and we believe it will — a potent help in time of trouble. More than that, its reading will suggest many intriguing possibilities for putting back to work abandoned apparatus now only gathering dust in the attic, resulting in better stations. Which, after all, is the quest of every one of us.

We renew the expression of our thanks to the numerous amateurs whose reports made this publication possible, and to Mr. Henry E. Neibert, KA9AH, of Milbuk, P. I., who first suggested the idea.

— EDITOR

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HINTS and KINKS

for the Radio Amateur

Chapter One

IN THE WORKSHOP

Cutting Sheet Aluminum

MOST amateurs at some time or other wish to make an aluminum cabinet and a receiver with plenty of inside shielding. The first question that comes up is that of cutting sheets to the correct sizes without going to the expense of having it done.

The answer is simple — break the aluminum. All the tools that are necessary are cheap and will be found around any amateur shack. Some kind of a sharp tool with which to mark the aluminum and two pieces of angle iron are all that are necessary.

Lay out the aluminum accurately. Then place the piece to be cut between the two pieces of angle iron with the line marked just showing above the angle iron. Clamp this firmly in a vise. Then take a sharp tool — a wood chisel will do the trick nicely — and with a firm pressure run along the line, making a deep cut in the aluminum. Repeat this three or four times. Then, leaving the aluminum in the same position, do the same thing to the other side. This will cut the surface of the metal and allow a clean break to result.

After making several of these deep cuts on each side, grasp the top of the sheet in both hands and work it slowly back and forth, being careful not to bend it too far in either direction. If you do this the aluminum will bend and will not be flat. After bending it back and forth until it breaks take a file and touch up the edges. If care is used in marking off the sheet, it will be the exact size because the aluminum cannot break in any other place except where it is marked.

If several small pieces of aluminum are wanted for brackets the idea is very well adapted for this kind of work. One long piece is first broken and then the small pieces can be broken one after another until the required number is secured. These only need touching up on the edges.

If a very long piece of aluminum is to be broken it will be necessary to place a "C" clamp on the end of the angle iron farthest from the vise.

If this is not done the angle iron will tend to spring apart, allowing the aluminum to bend at that end instead of breaking.

Aluminum up to $\frac{1}{8}$ inch has been cut by the writer in this style with entirely satisfactory results. Of course the thicker the aluminum the deeper will have to be the marking. It is surprising, though, how small a mark will permit the aluminum to break.

— P. D. Zurian, W9BMY

Cutting Round Holes in Aluminum

WHEN mounting sub-panel or manufacturer's type sockets in an aluminum-shielded receiver, the question comes up, "How can I cut a nice round hole in the sheet for mounting socket, tube, etc?"

I have solved this in the following manner:

First procure a pair of heavy carpenter's or machinist's dividers and with one leg drill a hole through till the point just comes through. With this as a center adjust the dividers to the radius of the hole desired and scribe a circle. Make several cuts and then turn the panel over and make several cuts on the reverse side. Open a vise just a trifle larger than the diameter scribed, lay the panel over the opening and strike the inside of the circle several blows with the ball end of a ball peen hammer. Turn over and repeat. Keep turning over till you have lost all confidence in this method, then hit it two or three more times and the inside will drop out, leaving a fine hole with no ragged edges.

— Charles M. Conley, W9CXG-W9CLX

Glass-Drilling Simplified

I HAVE drilled lots of holes in plenty of different pieces of glass of all different shapes, but so far have found only one satisfactory method. My first real experience at it was an attempt to drill 49 holes in an inch-thick transmitter panel and measuring 41 by 56 inches. It split on the 47th hole. After that I went to an expert glass worker and found out how it was done. Here it is for the

benefit of those in the ham ranks who wish to try any glass work.

First, the drill. It is made from a file of the three-cornered variety and must be picked so the size is correct for the hole to be drilled. The hole will always be slightly larger than the longest dimension through the file cross-wise. The file must be ground so that the drilling point is made on the large end, if the file is tapered. The handle end should be ground off on an emery wheel until

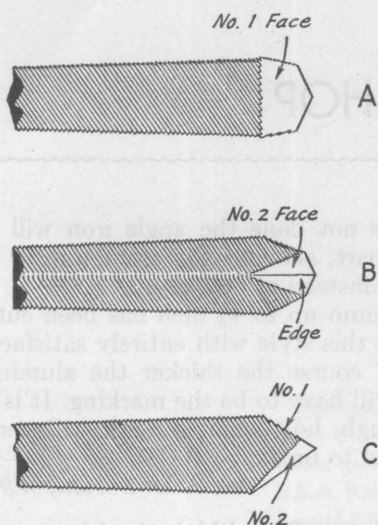


FIG. 1

HOW THE GLASS-DRILLING TOOL IS MADE

the end is square across and it must be ground until all of the smooth part is gone and the teeth come clear to the busy end. This is the first step. From here on the grinding must be perfect or the drill will not cut.

Hold the file so you are looking at one flat side and mark that side with chalk. This is the No. 1 side. The No. 2 side is then on your right and the No. 3 side to your left. Now make your No. 1 grinding so as to get a face on the No. 1 side which is the same depth as the width of the No. 1 side and sloping back to the center of the end of the file. The actual cutting edge of this No. 1 face must be at the center of the file or it will break every piece of glass you put it in. The slope of the No. 1 cutting face is about 30 degrees from the No. 1 side of the file. Now, grind another face exactly in back of the first grinding, so the center of this second face will be on a line with the edge of the file opposite the No. 1 cutting face. This second face will be triangular in shape and just deep enough to bring an edge at the center of the file. Now this second face must be ground on both sides to leave the back edge of the file angle in to the center of the edge of the first ground face. This will leave two small triangular facets whose outer edges are angular across the No. 2 and No. 3 sides of the file and whose inner edges are common and form the tapered cutting portion of the back edge of the file. The cutting

edge of these two facets will be also the cutting edge of No. 1 face. If the grinding has been properly done you will now have a No. 1 face with a four-sided cutting edge and a No. 2 cutting face having a sharp ridge up its center to the center of the cutting edge. Fig. 1 should make this clear.

Now, as the actual cutting operation is started, put the file in an ordinary brace and push hard while turning the brace as *slowly* as you possibly can. As soon as the bit makes the first bite you must put some turpentine in the cut and keep the cut soaked in it until the hole is finished. While drilling, keep plenty of pressure on the bit and turn the brace very slowly. Take nearly all the pressure off the bit just as it starts through the final side of the glass and go very easy from then until the hole is completed.

The glass *must* be supported so that it cannot bend while the cut is being made. A piece of linoleum under the cut is about the best thing. The drill must be wiped off as soon as it picks up a little glass and more turpentine put in the hole. Never let the drill get dry on the point as it will get dull in a second and generate enough heat to break the glass. Do not let the top of the brace wobble.

As long as the drill is sharp it will make a slight grinding noise and when it stops it must be sharpened immediately by slightly grinding all the cutting faces a little more. Be careful when sharpening the drills over to keep the cutting faces at the same angles as before.

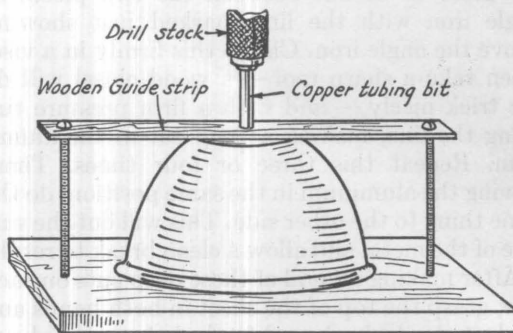


FIG. 2

The slower you can turn the brace, the faster you will drill the hole.

— Verdon Stones, W9BHF

Another Method for Large Holes

AFTER having spent countless hours using every imaginable means of drilling holes through glass, the following described method was tried and found to be the quickest and easiest ever used, with far less danger of breakage. Material necessary is a small can of valve grinding compound, medium; a piece of copper tubing, the size depending upon the size of hole desired; and a hand drill. If a speed drill is available the speed

and ease of drilling will be increased just that much more.

In drilling a hole through a glass bowl first lay the bowl bottom up on the bench or other flat surface and place three or four small brads around the edge to hold it firm. Next fasten a thin strip of wood over the bottom of the bowl to serve as a centering device for the hole to be drilled. First drill a hole the size of the copper bit through the center of the wooden guide and another small hole at each end to take a nail or long wood screw to fasten the guide. Fig. 2 should make this clear.

The bit, which is made from a piece of copper tubing, should be about two inches long. Fill it with the valve-grinding compound, and also fill the center hole in the wooden guide. In a short while a groove will be ground into the glass deep enough to hold the bit in place without the use of the wooden guide. Now remove the guide and keep adding valve grinding compound, at the location of the hole, until the drilling is completed.

— George Maki, K7HV

A Sure-Fire Inductance Clip

AFTER years of trimming and bending the ordinary type of small clip in an effort to make it

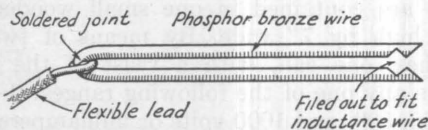


FIG. 3

serve as a decent terminal for the leads which must be tapped onto small wire wound inductances, I decided to do something about it.

Accordingly, a bit of No. 19 phosphor bronze spring wire was bent into the shape of a short hairpin as indicated in the illustration, Fig. 3. Before the free ends are brought too close together, they are filed as shown with a small triangular file so that when they are brought together a notch will be provided for the inductance wire to rest in. The flexible wire lead is then soldered to the tail end of the gadget, and at last we have a clip which will permit us to contact our wire wound inductances without shorting out the turn on either side of the one we want. A piece of spaghetti tubing should be slipped over the rear end of the clip to hide the soldered joint and provide insulation.

Possibly the same clip, made of heavier wire, would do for copper tubing coils also.

— Herbert Hollister, W9DRD

Plug-in Radio-Frequency Chokes

IN DESIGNING the usual crystal transmitter some provision must be made for the grid chokes to be used in the different stages. Usually these chokes are wired into the circuit by just soldering

the wires into place or by using ordinary binding posts. It is very difficult to try different chokes under these circumstances, and a person just uses the choke he has in there rather than go to the bother of changing it. Why not call upon the services of the ever-ready tube base to furnish the material for these chokes?

Scramble-wound chokes are most adaptable to this purpose, but small solenoids also can be used. A wooden dowel whose outside dimensions are slightly smaller than those of the inside of the tube base is grooved so that there are two slots about $\frac{1}{4}$ " in depth and $\frac{1}{4}$ " in width, as in Fig. 4. These slots are wound with the amount of wire desired and the leads led down through the prongs of the tube base and soldered in place. A small hole is drilled through the bottom of the tube base to accommodate a small screw for the purpose of holding the dowel in place. If a round piece of black cardboard is glued to the top of the completed form a very neat looking choke is the result.

— Tom Wherry, W9GKT

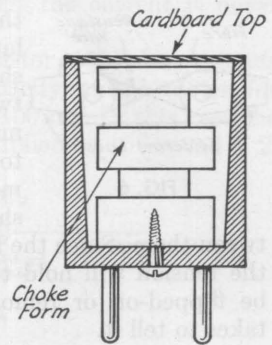


FIG. 4

Handy Coil Mounting

IN MAKING plug-in receiving or transmitting coils which are of such size that they cannot be wound on tube bases, secure a dozen or so phone tips, tap out the sleeve end with a 6-32 tap and fasten this tip to the coil form by screwing a 6-32 brass machine screw through the coil form into the tip, as shown in Fig. 5. In case the coil form is of thin material, fiber or brass washers can be used on both sides of the coil form walls to strengthen it.

These tips can be conveniently plugged into tip jacks, which make a good tight connection and hold the coils steady, whereas a wire fastened to the coil and inserted into a binding post leaves the coil wobbly and inconvenient to handle, with a possibility of a loose connection.

— Samuel W. Bayliss, W4ARF

A Flip-On Meter Shunt

W9CTV contributes a handy kink for those who make frequent use of their d.c. meters. It is a shunt

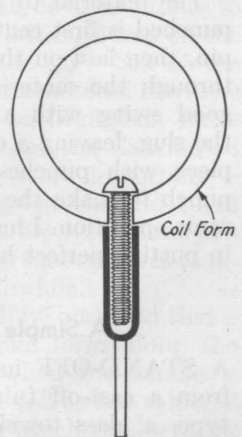


FIG. 5

which can be stuck between the terminals on the back of the meter without the necessity for unfastening any wires or using binding posts.

Fig. 6 is a drawing of one of the shunts. A small piece of flat fiber has holes drilled near each of its ends, and soldering lugs are fastened to the strip by eyelets or short machine screws. The required quantity of resistance wire is wound

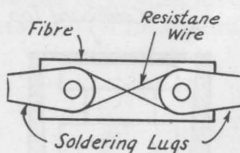


FIG. 6

back and forth between the two lugs. The ends of latter are trimmed off as shown, the distance between the two ends being made just the right length to fit snugly between the meter terminals when the shunt is pushed in between them.

Since the lugs are somewhat flexible the tension will hold the shunt in place. It can be flipped-on or removed in less time than it takes to tell it.

A Socket-Hole Punch

FIG. 7 illustrates an excellent tool for securing those perfect tube socket holes in any kind of sheet metal.

Cut a 9-inch length of pipe of the correct diameter, thread one end and grind the other perfectly flat. Fit a pipe cap to the threads and tighten it well; center a piece of drill-stock, or any other piece of round steel, in the center of the pipe and fill with babbitt. A flat piece of $\frac{1}{2}$ " steel 4" square is drilled in the center with a bit slightly larger than diameter of the pipe. This plate is then mounted solidly on a wooden block in which a hole is drilled to pass the pin.

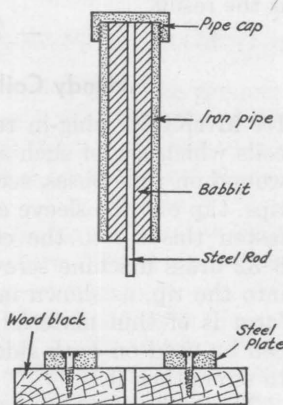


FIG. 7

The material to be punched is first centered and drilled to pass the pin, then laid on the plate and the pin inserted through the material and into the block. One good swing with a heavy hammer shears out the slug, leaving a clean, perfect circle. A cross-piece with punches can be placed across the punch to make the rivet mounting holes in the same operation. I have used this tool successfully in putting perfect holes in heavy furnace metal.

— W9HMQ

A Simple Stand-Off Insulator

A STAND-OFF insulator which can be made from a cast-off tube socket of the metal shell type, a glass towel rod and a little cement is shown in Fig. 8. The prongs should be removed

from the socket, leaving only the shell and base, then the glass rod is centered in the socket and cement poured in. The cement should be quite rich — practically all cement and little sand. Care should be taken to keep the rod aligned until the cement has hardened.

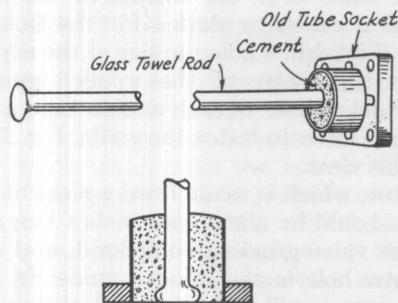


FIG. 8

One advantage of this type of insulator is that it can be made in almost any length desired. R. B. Newhauser, W9HWO, suggested the idea.

A Multi-Range Voltmeter and Milliammeter

THE voltmeter herewith described has the advantage of being compact and convenient — all the resistors, shunts, switches and the movement itself, are contained in one small wooden box $6\frac{1}{2}$ " high by 7" wide. By means of two tap switches, one can, with a twist of the wrist, choose any one of the following ranges: 0-1, 10, 50, 250, 500, and 1000 volts or milliamperes.

The meter is a Weston model 301, bakelite case, with a range of 0-1 milliamperes, having a resistance of 27 ohms. This was first dissected in order to get at the scale, which is accomplished by removing the three very small screws in the side of the case after which the "works" can be slid out. It might be noted in passing that the one small screw hole which is usually soldered and sealed is in this model filled with some kind of compound which can easily be chipped out, saving the rather mean job of melting out the solder. A scale having the desired readings was dug up in one of the Weston catalogs describing their analyzers. This was carefully cut out and pasted over the 1-mil. scale. I understand that scales with any particular readings may be obtained from the manufacturer, but if care is exercised in the pasting process, a very neat job will result.

The box used is one of those old Signal Corps detector units and the switches also were taken from the panel furnished with it. These switches, the meter and three Eby binding posts are mounted on a bakelite panel about 5 by 6 inches. A small rack made from brass strip is mounted on the back to support the resistors.

The voltmeter resistors are Shallcross "Acrachohms," and the shunts are home-made from resistance wire of about 10 ohms per foot, wound

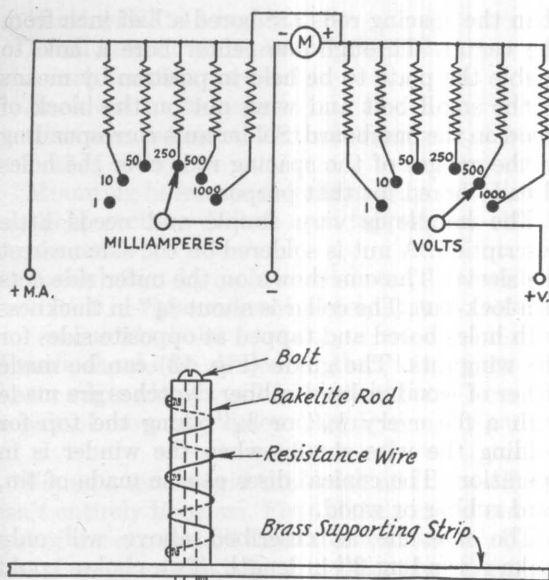


FIG. 9

on bakelite rods. The values of each are given in the table below.

Range	Volts	Ma.
0-1	1,000 ohms	0.000 ohms
-10	10,000 "	3.000 "
-50	50,000 "	.551 "
-250	250,000 "	.108 "
-500	500,000 "	.054 "
-1000	1,000,000 "	.027 "

This, of course, gives a 1000-ohms-per-volt voltmeter, the high resistance of which enables one to make measurements without materially altering the circuit constants, which often happens with a low-resistance unit. The shunts were measured up on a Wheatstone bridge before being put together, and then wound as shown in the drawing. For the higher ranges, four or five lengths of the wire are used in parallel to be on the safe side so far as current-carrying capacity is concerned. The wiring of the meter is shown in Fig. 9.

As well as providing a number of meters at the cost of one or two, this instrument saves a lot of handling of various meters. It is mounted upon a shelf at about eye level in my shop, and two 'phone cords terminating in 'phone plugs are connected to the binding posts. The proper varieties of jacks are employed in the various electrically strategic points. It is a simple matter to plug in for the reading. — Leonard B. Gallup

Using Low-Range Voltmeters as Milliammeters

OCCASIONALLY a milliammeter is required when there is none available. The small d.c. voltmeters having a range of 0-10 volts and a resistance of about 50 ohms per volt make very effective substitutes.

Referring to Fig. 10A, such a voltmeter is connected in the conventional way in series with

the rest of the circuit. The meter will pass 20 ma. when the needle indicates 10 volts, and since the scale is laid off in equal divisions, multiplying the voltmeter reading by 2 gives the current in milliamperes. It is true that this scheme involves adding resistance to the circuit, but the voltage drop across the meter will never be greater than the maximum reading of the meter, which is very small, assuming that the current is never over 20 ma.

In Fig. 10B, a shunt resistor of 125 ohms extends the current-carrying capacity of the meter for use in a circuit carrying 100 ma. In this case the voltmeter reading is multiplied by 10 instead of 2.

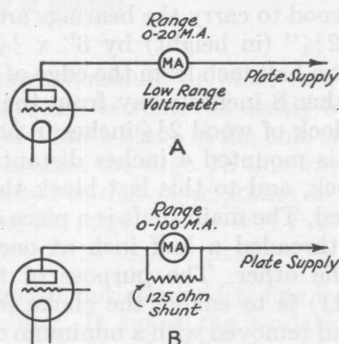


FIG. 10

If the resistance of the voltmeter is not known, it may be determined by placing it across a suitable battery and noting the reading. Then if resistance is added in series with the voltmeter until the voltmeter reading is only one half the previous reading, the series resistor will have the same value as the internal resistance of the voltmeter. The meter could also be calibrated by placing it in series with a standard milliammeter.

— Donald B. Bradshaw, W1IB

A Winding Machine for Spaced-Turn Chokes

SPACE-WOUND chokes are made easily if one has a screw-cutting lathe, but these expensive items seldom form part of a ham's equipment. The following description of a machine for winding spaced chokes will, I trust, be of assistance to hams not in possession of lathes. Most of the material will be found in the junk box of the average ham, but even if all the material has to be purchased the cost would be negligible. Since spacing the windings decreases the distributed capacity of a choke and — more important — raises the breakdown voltage at the end turns where the voltage per turn is always highest in a transmitter of any power, the time spent in making the machine is well worthwhile.

Referring to Fig. 11, it will be observed that a traverse motion of the choke form along the horizontal rod is obtained when the handle is turned in a clockwise direction. The nut soldered to the circular plate through which the threaded spacing rod screws moves the choke form along,

the number of turns per inch being dependent upon the number of threads per inch on the spacing rod.

A piece of wood approximately 16" x 4" x 1" will serve nicely as a baseboard, and to this two

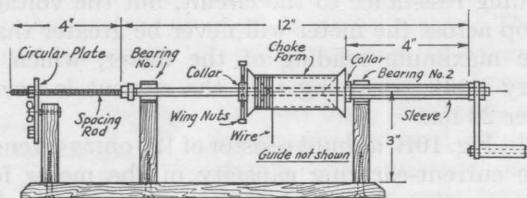


FIG. 11

blocks of wood to carry the bearings are screwed; these are 2 3/4" (in height) by 3" x 1/2". One is fixed about a half inch from the edge of the board and the other 8 inches away from the first one. Another block of wood 2 1/2 inches in height, also 3" x 1/2", is mounted 4 inches distant from the second block, and to this last block the circular plate is fixed. The main shaft is a piece of rod 12" in length threaded a half inch at one end and 1 1/2" at the other. The purpose of the sleeve (see Fig. 11) is to enable the choke form to be inserted and removed with a minimum of trouble. If the main shaft is released from the socket on which the spacing rod is soldered, it is only necessary to unscrew the wing nuts on the collar and the main shaft can be instantly withdrawn, thus releasing the choke form. The sleeve is 4" in length and of sufficient diameter to allow the main shaft to pass through freely. A collar about 3/8" in length is soldered over the end of the sleeve nearest the conical disc. Without this collar the tubing is likely to cut into the conical disc if it is made of hard rubber or other soft material, especially if a thin tube is used for the sleeve.

The bearings are both 1/2" in length. No. 1 can be a piece similar to that used for the sleeve. No. 2 will have to be large enough in diameter for the sleeve to pass through. The bearings are soldered to brass "saddles" and screwed to their respective bearing blocks.

The spacing rods are four inches in length. An assortment of rods with different thread pitches will allow a choice of different spacings between turns. One end of each rod is soldered to a socket (which may be made from an old binding post) as shown in Fig. 12. Care should be taken to see that sufficient space is left, after soldering the rods to the sockets, for the main bearing shaft to screw firmly in the socket. A simple way to insure this is to screw a piece of wood halfway through the socket, place it upright in a vise and after centering the spacing rod in the socket run the solder into the surrounding cavity.

The circular plate is a disc of 10 gauge brass 3" in diameter. Holes slightly larger in diameter

than the spacing rods are bored a half inch from the center. Through the center bore a hole to enable the plate to be held in position by means of the small bolt and wing nut on the block of wood on the baseboard. Solder nuts corresponding to the gauges of the spacing rods over the holes already bored for that purpose.

The handle is very simple and needs little description. A nut is soldered on the side nearest the sleeve. The one shown on the outer side acts as a lock-nut. The collar is about 1/4" in thickness with holes bored and tapped at opposite sides for the wingnuts. The guide (Fig. 13) can be made either of wood or hard rubber. Notches are made with a file every 1/8" or 1/4" along the top for holding the wire steady when the winder is in operation. The conical discs can be made of tin, hard rubber or wood.

The machine as described above will only make a winding 3" in length. Two chokes could be wound and placed in series if it were necessary to wind a choke on a form greater than two inches in diameter. Hard rubber or fibre tubing cut into 4-inch lengths is used by the writer as choke forms. After the shaft, discs and choke form have been placed in position the wingnuts on the collar are tightened up and on turning the handle pressure on the sleeve will center and tighten up the form, after which the locknut at the handle end of the rod can be fitted.

When winding chokes of say 100 turns, to decrease the distributed capacity it is a good idea to use a spacing rod with about 50 turns to the inch and after winding 25 turns remove the wire to the next notch cut on the top of the guide. The same procedure is followed after each 25

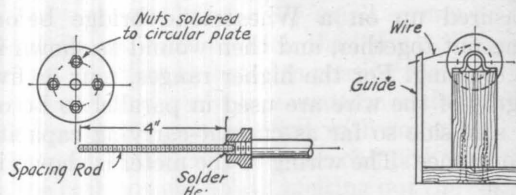


FIG. 12

turns wound, the result being a spaced choke with additional spaces between sections.

A number of improvements will suggest themselves to hams; in fact I have made several myself, but to make things as clear as possible I have shown and described the machine originally built.

— W. H. Heathcote, ZT6X

Relay Rack Facts

AMATEUR stations of any pretensions usually follow the relay-rack type of construction, and the appearance of even small layouts often can be improved by its adoption. Some of the fellows are having difficulty in finding the dimensions of standard relay racks, however, so here are the figures:

Panel width: 19 inches.

Panel height: multiples of $1\frac{3}{4}$ inches, less $\frac{1}{32}$ inch for clearance.

Rack width: 20 inches.

Clearance between vertical members of rack: $17\frac{1}{2}$ inches.

Mounting holes: spaced alternately $\frac{1}{2}$ inch and $1\frac{1}{4}$ inches, drilled and tapped for 10-32 screw.

Panel holes: $\frac{1}{4}$ inch in diameter, centered $\frac{3}{8}$ inch in from edge of panel, spaced same as mounting holes in rack.

Panels should be drilled so that the upper and lower edges always will fall just halfway between a pair of mounting holes spaced $\frac{1}{2}$ inch apart.

Fixing a screen-grid tube with a broken-off cap isn't entirely hopeless. First clean the old cement out of the cap and fill the latter with solder. Clean the glass tip of the tube and shine the remaining length of grid lead. Invert the cap on a flat surface, get the solder filling hot, plunge the tip of the tube in the cap, let cool, and the job is done.

— W6BQU

When testing to see if a transformer winding is continuous, many hams are accustomed to using a small electric-light bulb connected in series with the 110-volt line. If the winding delivers high voltage the resistance may be too great to permit enough current to flow to light the lamp. In cases like this one of the small neon bulbs, substituted for the lamp, will make a good indicator, since the current taken by the neon bulb is minute.

— W2BRY

W2DPH sends in the following formula to keep the drill lubricated in drilling holes through glass:

Camphor, 1 oz.

Spirits of turpentine, $1\frac{1}{2}$ oz.

Ether, $\frac{3}{8}$ oz.

To make old bakelite dials look like new, scratch out the old paint in the engraving with a sharp-pointed instrument, spread on aluminum paint and wipe off the excess. The aluminum paint will remain in the grooves. — W1BPK

A hint for putting a finish on aluminum panels: If a small hunk of cloth is wadded up in the jaw

chuck of a lathe or electric drill, wet, sprinkled with carborundum powder, and applied to the panel with pressure determined by experiment, a pleasing whorled finish will result. Care must be taken, however, that the chuck does not touch the panel in its mad flight or the panel will be ruined.

— W2DWO

Hard-drawn copper tubing can be made soft to facilitate winding coils by heating it in a hot fire or blow-torch flame until red-hot, then dropping it suddenly into cold water. The rapid cooling softens the copper and at the same time loosens the copper oxide coating which forms when the tubing is heated.

In drilling aluminum or other soft metal the jagged edges can be removed neatly by inserting the point of a knife-blade in the hole and rotating the blade around the edge. In this way the metal is not exposed to digs or scratches as in filing or hammering the edges.

— W1CPH-W8EJX

Commercial muriatic acid is fine for polishing copper tubing. It takes the oxidation off like lightning. A coat of thin clear lacquer will preserve the finish.

— W5AIB

To remove paint from aluminum or enamel from wire, submerge the article to be cleaned in a concentrated lye solution and let it soak. After the paint has come loose, wash off the metal with hot water.

— W1CNU

W2AUL has been very successful in cutting finished crystals and oscillating blanks into sections by placing the blank or crystal on a flat piece of wood and sawing carefully with the back of a hacksaw blade, using "F" carborundum as an abrasive. In several instances he has cut one-inch square crystals into four parts and by edge-grinding has succeeded in developing four crystals where there was only one before. By finishing one side of each of the crystals slightly they can all be put on different frequencies. Cutting through the crystal takes about a half hour using the method described above. All of the crystals were "Y" cut.

Chapter Two

IDEAS FOR THE RECEIVER

R.F. Transformer With 5-Prong Coil Forms

THE advantages of transformer coupling between r.f. and regenerative detector have been pointed out several times in *QST*, but the difficulty often is that the owner of the set with impedance coupling wants to use the five-prong coil-forms on which his old coils are already wound, while the usual transformer arrangement requires six prongs for the detector coil. Fig. 1 shows one method of solving the problem. Everett Kick, W7EK, has been using it with success.

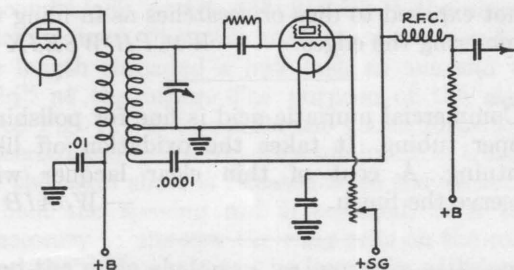


FIG. 1

R.F. TRANSFORMER FOR DETECTOR CIRCUITS
Only 5 prongs are needed on the coil form with this circuit.

The heart of the stunt is to use the Hartley circuit for the detector instead of having two separate coils for grid and tickler. Only three prongs are required for the detector circuit, leaving two open for the transformer primary. The ground tap must be placed at the right point on the coil for most satisfactory oscillation control, which may require a little cut-and-try but is not difficult. The radio-frequency choke in the plate circuit must also be good at all frequencies at which the receiver is to work, otherwise there may be some "holes" in the tuning range at which the detector will not oscillate. W7EK says that with this arrangement the signals are at least twice as loud as with the impedance-coupling previously used, while the background noise have gone down considerably. It will pay to experiment a little with the primary to get the right number of turns for maximum signal strength.

Cutting Out Tunable Hums

ONE annoyance sometimes encountered with home-built "B" supply units for receivers is the so-called "tunable" hum, or hum which appears only when the detector tube is oscillating, and then often at only certain groups of frequencies.

These hums seem to be unaffected by the amount of filter used, and a "B" supply which shows no trace of hum when used with a non-oscillating receiver frequently is a bad offender in this respect. Again, the hum may be completely absent if the antenna is disconnected from the receiver, only to appear with full strength just as soon as the antenna is hooked on.

A simple scheme which has worked to perfection in several cases of this kind is shown in Fig. 2. It consists simply in by-passing the elements of the rectifier tube; that is, connecting a condenser of .001- μ fd. capacity or thereabouts between each plate and the filament center-tap of the rectifier tube. The capacity used is not critical. Ordinary mica receiving condensers will stand up if the inverse peak voltage across the tube elements is not more than 500 volts.

This scheme has done a good job of eliminating hum when ordinary r.f. filters between the rectifier tube and the input section of the filter failed utterly.

Simplifying Band-Spread

THE use of a tapped receiving coil with the tuning condenser connected across only part of it for band-spreading has been revived recently and has been used in several receivers described in *QST*. One of the problems it has brought up is that of finding room for an extra contact on already-crowned coil forms. Here is how Vern Milton, W6EPW, solved it:

"Upon completion of a new receiver recently I

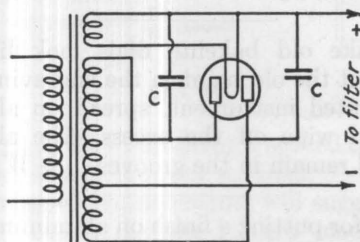


FIG. 2

FIXED CONDENSERS CONNECTED ACROSS RECTIFIER TUBE ELEMENTS ARE EFFECTIVE IN ELIMINATING TUNABLE HUMS WITH "B" SUBSTITUTES

found that I had far too much band spread on 80 and not enough on 40. Not having any UY sockets on hand, I had to figure out a way to get band-spread using UX sockets and a large condenser. The circuit of Fig. 3 is the one finally adopted. It will be noted that the rotor plates of the tuning condenser, instead of being con-

nected to one side of the coil go to the filament. This allows use of the circuit without insulating the condenser from the metal panel and at the same time it simplifies the circuit and reduces the hand-capacity effect.

"This is the only circuit I have ever seen that allows band-spread with a condenser having but one section and with coils on four-prong bases. A few other desirable qualities are that the set oscillates with ease on all bands, there is less frequency drift than with the ordinary circuit — the set will stay at one frequency even with quite a change in plate voltage, which is an advantage when using a 'B' eliminator — and the noise level is decreased in favor of the signal.

"Although this set was used with d.c. tubes the circuit could be changed easily for a.c. operation. It should be very good for use in a portable

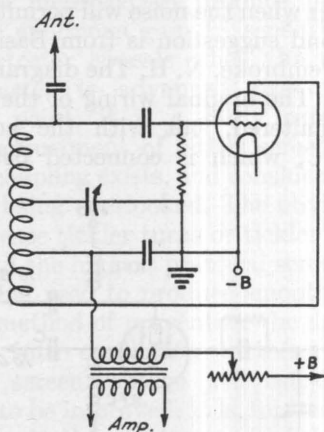


FIG. 3

TAPPED-COIL METHOD OF BAND-SPREADING WITH 4-PRONG COIL FORMS

receiver, since a single-pole double-throw switch with the blade connected to the stator plates of the tuning condenser and one contact at the grid end of the coil and the other at the tap will permit either band-spread tuning or a large coverage with the same coil. This will cut down the number of coils needed."

The Two-Tube Detector

H. T. PETERSEN, OZ7Z, recommends the diagram shown in Fig. 4 for the screen-grid detector circuit. It is another of the family of circuits using a separate tube for regeneration. The screen-grid tube is the detector, while the triode furnishes the regeneration and oscillation. The voltages on the screen-grid detector may be adjusted for maximum sensitivity without making allowance for regeneration control. Likewise the triode circuit may be adjusted for greatest smoothness of control without making concessions for sensitivity.

OZ7Z says the arrangement gives excellent signal strength with a minimum of background noise. The antenna coils should be loosely

coupled to the grid coil. The two tubes should, of course, be mounted close together to make the connections short and direct.

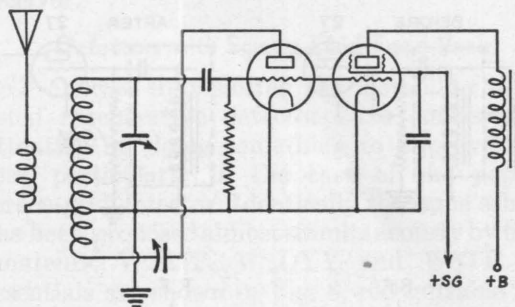


FIG. 4

R.F. Control on the SW3

THE following dope from R. B. Fogarty, W9IST, should be of interest to SW3 owners who have been wondering about the possibility of using an r.f. gain control on the set:

"I was quite interested in the article in the January, 1933, issue of *QST* on improving the selectivity of the autodyne receiver. As a result of that article I made some changes in my own receiver and the results have been so good that I have passed the dope on to other hams and thought perhaps you might be interested in passing it along to the gang.

"I have a National SW3 and have made the following changes: The 500,000-ohm tapered potentiometer was removed from the circuit and a 1-megohm resistor put in place of the potentiometer, as shown at A, Fig. 5. In the first r.f. circuit I put in a control as suggested in the above-mentioned article. I used a Yaxley 10,000-ohm tapered potentiometer, mounted in the place formerly occupied by the 500,000-ohm volume control. It was not necessary to drill any holes, and the graduated R disc still serves its purpose. The circuit changes are shown at B, Fig. 5.

"As for results — they are quite astounding! There is a station very near me that used to block out about $\frac{3}{4}$ of the band on 40 meters. Last night I worked a W3 within one point of this local ham! And he was as strong as ever because I could turn up the r.f. gain control and he would still block out the band as before.

"I have passed this dope on to five or six hams and they have been very pleased with their results. One is a 'phone man and he is working stations now he couldn't even hear before.

"I might add it works equally well on both sets — either 35 or 58 tubes. On the 58 set it is even better as it cuts down the tube noises so that weak sigs come through much better.

"As for detuning the set — I have noticed that it throws sigs off about a half degree on the dial. Personally I can't kick about that as I can work many more stations now thanks to this change."

In using a similar arrangement to give r.f. gain control on the SW5 it was found by W1BDI that changing the detector wiring to the circuit shown in Fig. 8, page 13, helped to compensate for the

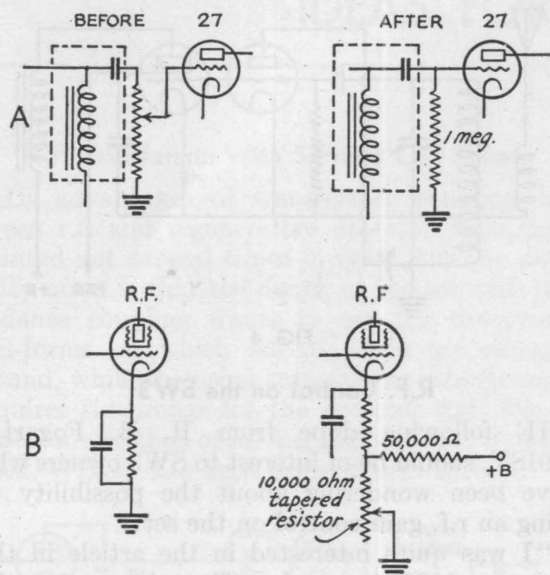


FIG. 5

The unconnected condenser in the last diagram goes to ground.

detuning. Probably such a change would be equally helpful on the SW3.

The Type '38 as a Screen-Grid Detector

WHILE experimenting with some of the new six-volt tubes, we found that the Type '38 pentode would work very well as a screen-grid detector.

Our receiver was designed to use one of the Type '36 tubes as a detector, but it was found that the pentode would oscillate just as readily as the Type '36 without making any changes in the circuit or voltages.

The '38 probably has no superiority over the '36 in sensitivity as such a detector, but has a lower plate impedance, making it easier to secure a good output load for the tube.

—John Coykendall, W9GKL

Some Converter Hints

PROBABLY a good many readers who built converters of the type originally described in *QST* for July, 1930, are still using them. Here are two suggestions for improving the operation of the converter.

The first is from Theodore Clark, of 1358 E. 58th St., Chicago, Ill. He writes, "I built such a set for a.c. tubes with separate plate supply. The set perked but feebly. A long set of experiments followed which convinced me that the tie-up of oscillator plate and the detector control grid through a fixed resistor wasn't too sound; first, because it made the voltage on the one too much a function of the other, and second, because the coupling resistor of 50,000 ohms offers consider-

able impedance to short waves or any other kind. (This latter difficulty can be overcome by connecting a small by-pass condenser across the coupling resistor. This was found to be unnecessary in the original model, probably because the resistor used had enough self-capacity to make its impedance small for r.f. — Editor.) Hence I finally changed the layout slightly to make the detector control grid bias independent of oscillator plate, as shown in Fig. 6. The 100,000-ohm resistor gives a 20-volt bias on the control grid. The condenser *C* is mounted on clips so as to be easily changeable. I now use a .00004 Sangamo and leave it alone. Otherwise the constants are unchanged.

"This layout seems to be extremely sensitive, and used in conjunction with a superhet b.c. receiver goes down to the noise level without effort. I readily get G5SW and VK3ME on the loud speaker when the noise will permit."

The second suggestion is from Basil Cutting, W1APK, Pembroke, N. H. The diagram of Fig. 7 explains it. The original wiring of the converter remains unaltered, but with the addition of condenser *C*, which is connected between the

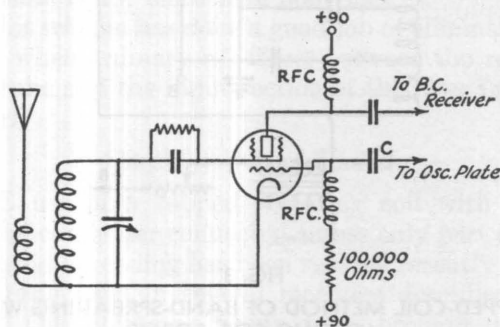


FIG. 6

oscillator plate and the antenna post. This condenser is a midget with a maximum capacity of about 100 μfd . Its function is to introduce some regeneration in the first detector, thereby increasing its sensitivity. If *C* is made large enough the detector will oscillate, which is of

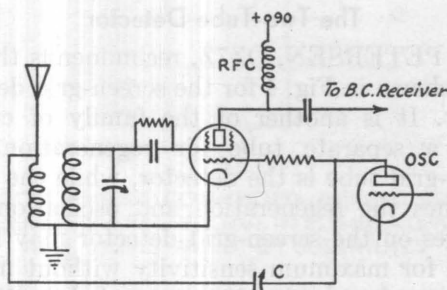


FIG. 7

course undesirable. Tuning and adjustment are likely to be more critical than without regeneration, but a decided increase in signal strength will result.

Screen-Grid Voltage and Detector Sensitivity

ALTHOUGH it is pretty generally realized that a high order of sensitivity can be obtained with a screen-grid regenerative detector, many amateurs are not aware of the importance of having the correct screen voltage on the detector. The dope given in the following letter from J. C. Flippin, W8BQY, is well worth putting into practice:

"There may be some amateurs who are failing to obtain maximum sensitivity from a 224-227 receiver by using too many turns on the tickler of the '24 detector, causing the latter to break into oscillation with an insufficient amount of voltage on the screen grid.

"In my own experience the higher this s.g. voltage can be, without roughening up the regeneration control, the better. As the screen voltage is increased to produce oscillation, a relatively enormous gain in sensitivity results. If the detector squeals when the regeneration potentiometer is advanced past the normal 'slide-in' point, it is a fairly sure indication that maladjustment of either screen voltage or antenna coupling exists, and considerable socking power is being overlooked. The obvious remedy is to decrease tickler turns or tickler coupling, or both, until the highest practical screen-grid voltage is being used to produce smooth oscillation.

"Any method of preventing the detector from breaking into oscillation with an inadequate value of screen voltage will cause the signal response to be improved. It is, for instance, possible to couple the antenna so tightly to the detector grid coil that the detector will not break into oscillation without raising the screen-grid voltage to a higher-than-ordinary value. It is, however, in my experience preferable from the standpoint of both selectivity and smoothness of regeneration control to use a low value of antenna coupling, and decrease the reaction of the tickler upon the grid coil to bring about the aforementioned benefit.

"The effectiveness of proper adjustment in this respect is quite marked. The volume of all signals is heightened appreciably and the pick-up in the strength of DX is particularly noticeable. By bringing the sensitivity of the receiver up to a maximum, it is, of course, possible to employ a much smaller antenna than seems feasible with a receiver which operates indifferently without a fairly good antenna. The efficacy of the small pick-up in closely packed regions of interference, as in cities, needs no comment. It is also valuable where static is encountered, and I have found this to be especially helpful during the last couple of months.

"This simple adjustment may be overlooked by the chap who has, perhaps, centered attention primarily upon smooth oscillation, believing that the tickler is O.K. if it causes oscillation over the

band on one potentiometer setting. That is only part of the story. The screen-grid voltage — its proper adjustment — has a very material bearing upon signal strength and DX ability of the receiver."

Detectors with Screen-Grid Feed-Back

QST articles emphasizing the instability of the usual regenerative detector have concentrated attention on doing something to improve matters, particularly in the case of the popular screen-grid detector. Identically the same scheme has been proposed almost simultaneously by three amateurs, W2AIF, W8DYY and W5TR. Its essentials are shown in Fig. 8, recognizable as a sort of adaptation of the electron-coupled oscillator as it was first given in "Stabilizing Superhets" April, 1932, *QST*. The diagrams show how the usual screen-grid regenerative detector, as used in the National SW3, SW5, etc., can be re-

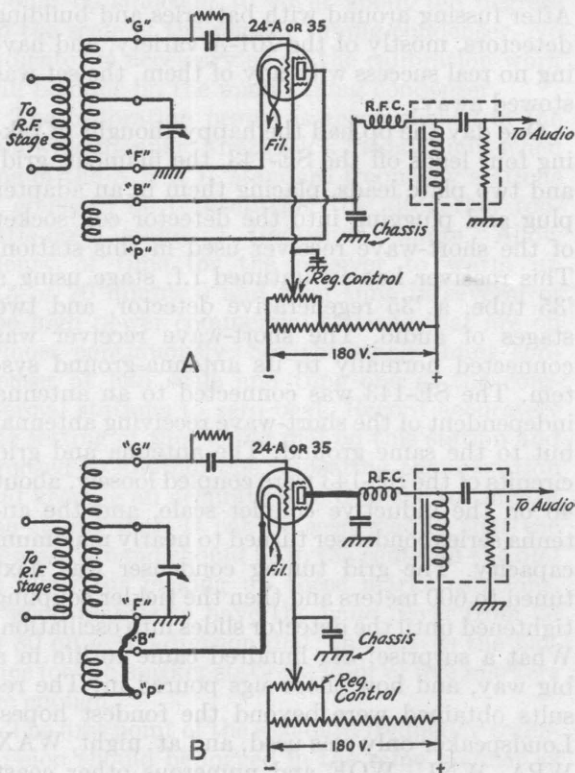


FIG. 8

DETECTOR WITH SCREEN-GRID FEED-BACK

A — the usual screen-grid regenerative detector, B — the revised circuit, with changes shown in heavy lines. Circuit constants are usual, although in B a smaller tickler may be used.

wired to use it. Advantages claimed are more stable oscillation, less blocking, reduced background hiss, smoother regeneration control and just as good, if not better, sensitivity. Incidentally, the idea is not unlike the scheme of using the tickler in the screen-grid circuit, as it was described by Howard Cassler in December, 1931, *QST*. The essential difference is that here the screen is at ground r.f. potential and the cathode

is "up in the air," whereas the screen was fed through a choke and the cathode was grounded in the older arrangement. Basically, however, both are the same breed.

An Adapter for the SE-143

MANY of us in amateur radio have been told that our operating is not as it should be; often it has been suggested that we should listen more on 600 meters where commercial operating is reputed to be at its best. The average amateur has encountered difficulty in building a receiver for this wavelength that is selective enough to exclude the powerful signals of broadcast stations in the adjacent band, or else he doesn't care to spend the money to build such a set.

This station, because of its activity in the Navy Volunteer Communication Reserve, was loaned an SE-143 receiver. This receiver is equipped with a crystal detector, with provision made for a vacuum-tube detector to be added externally. After fussing around with batteries and building detectors, mostly of the 201-A variety, and having no real success with any of them, the set was stowed away.

One day the op had the happy thought of taking four leads off the SE-143, the filament, grid, and two plate leads, placing them in an adapter plug and plugging into the detector coil socket of the short-wave receiver used in this station. This receiver has an untuned r.f. stage using a '35 tube, a '35 regenerative detector, and two stages of audio. The short-wave receiver was connected normally to its antenna-ground system. The SE-143 was connected to an antenna independent of the short-wave receiving antenna, but to the same ground. The antenna and grid circuits of the SE-143 were coupled loosely, about 40 on the inductive coupler scale, and the antenna series condenser turned to nearly maximum capacity. The grid tuning condenser was next tuned to 600 meters and then the tickler coupling tightened until the detector slides into oscillation. What a surprise! Six hundred came to life in a big way, and how those sigs poured in! The results obtained were beyond the fondest hopes. Loudspeaker only was used, and at night, WAX WPA, WNU, WOE and numerous other coast and ship stations came in R9 plus. The '35 oscillates smoothly, with no backlash, grunting or fringe howl over the whole wavelength range of the receiver. No interference is experienced from nearby broadcast stations.

With the necessity of building a detector and audio system eliminated, and no batteries to fool with — just four leads and an adapter plug to suit your short-wave receiver coil socket — the SE-143 is made practical for the amateur.

— J. E. Ploucher, W3BRB

The same idea can be applied to other similar receivers, no doubt with equal success. A great

many amateurs own government surplus Signal Corps and Navy sets covering the range between 250 and 2500 meters, a large number of which are not being used just because of the bother of building detector and amplifier equipment to go with

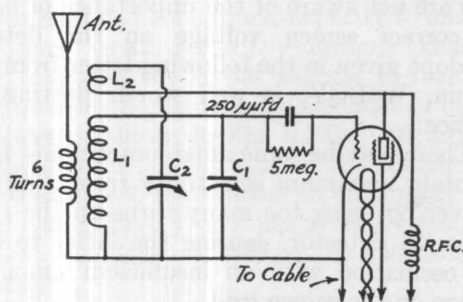


FIG. 9

SINGLE-TUBE CONVERTER CIRCUIT

C_1C_2 — 50- μ fd. midget condensers.

RFC — Short-wave choke (this choke must be big enough to permit the tube to oscillate but not big enough to choke off the i.f. signal fed through the plate wire to the broadcast receiver. Use a small choke.)

Coils — 3500 kc. — L_1 , 20 turns; L_2 , 12 turns.

7000 kc. — L_1 , 10 turns; L_2 , 7 turns.

14,000 kc. — L_1 , 5 turns; L_2 , 6 turns.

All coils wound with No. 22 d.c.c. wire.

them. This simple scheme is certainly worth a trial. — Editor.

A Single-Tube Converter

MOST ham receivers are operated with headphones, which are not very well adapted to letting the rest of the family hear the interesting things going on in the region below 200 meters. But with a couple of midget condensers, some coils and a few other odd parts it is quite easy to make a converter which will do the trick if one has a sensitive broadcast receiver. The outstanding features of the circuit, Fig. 9, described here are simplicity and very low cost; nevertheless it will give excellent results.

The converter will couple into any sensitive receiver using a screen grid tube in the first r.f. stage. No external power sources are required, since filament, screen and plate voltages are picked up from the broadcast receiver itself through the adapter plug — an old 5-prong tube base — which replaces the first r.f. tube in the receiver when this tube is placed in the converter.

The circuit resembles that of an ordinary single-tube regenerative receiver. The plug-in coils are wound on tube bases (only 4 prongs are necessary), both windings being in the same direction with the plate and grid terminals at the extreme ends to insure oscillation. The spacing between L_1 and L_2 will depend upon a number of factors and can be determined by experiment. The prime requisite is that the tube must oscillate. The primary coil is fixed and consists of 6 turns of No. 16 d.c.c. wire so placed that it surrounds the lower part of the plug-in coil when the latter is placed in its socket.

Several values of grid leaks should be tried. A 5-megohm leak has been found to be entirely satisfactory in most instances, however.

There will be one spot on the tuning dial of the broadcast receiver at which the converter will be the most sensitive. This spot must be determined by the builder himself, but the writer suggests that the receiver be tuned first to a frequency setting close to 800 kc. If this combination does not work well then another setting should be tried until the correct one is found.

Instructions for operating are very simple:

First: Remove the 1st r.f. tube from its socket and put it in the converter.

Second: Place adapter plug in vacated socket of the receiver.

Third: Plug one of the coils in the coil socket of the converter.

Fourth: Turn on switch in broadcast receiver and you are now ready to begin tuning in the short waves.

* The broadcast receiver can be used as a vernier tuning control after a signal has been brought in, performing this function simply by changing the setting of the intermediate frequency. Should a broadcast station be coming in through the short-wave signal the offending signal can be entirely eliminated by shifting the intermediate frequency and then retuning the converter to bring in the desired one.

To log the converter, simply make a note of the setting of the broadcast receiver and the converter setting at which the signal was heard. Changing the intermediate frequency changes also the dial setting on the converter.

If the converter has been wired properly and the receiver used in conjunction with it is at all modern no trouble should be experienced in bringing in foreign broadcasting stations in eastern U. S. as well as all kinds of domestic short-wave broadcast and amateur 'phone signals.

— *R. B. Kingsbury*

(EDITOR'S NOTE. — The ultra-simple type of converter, in which the functions of oscillator and first detector are combined in a single tube, is particularly subject to image interference and two-spot tuning. For casual listening, however, a converter such as Mr. Kingsbury describes can be built in a comparatively short space of time, whereas under the same circumstances the construction of a more elaborate converter might never be attempted.)

Accurate Calibration of a Receiver

CALIBRATED receivers apparently have been overlooked in the mad scramble for heterodyne frequency meters. However, it is possible to calibrate a receiver and maintain its calibration to as high a degree of accuracy as is possible with many heterodyne frequency meters, and it is most certainly a lot handier when one wants to check the frequency of an incoming signal.

The accuracy of the calibration and the ability of the set to hold this calibration will of course depend on how well the instrument is constructed. Rigidity is one of the prime factors in any frequency measuring device and also should be observed rather closely in any receiver. To hold calibration well a receiver must have rigid wiring, good connections, and above all rigid condensers and indicating equipment. A little care in the original construction of the receiver will be repaid by the "holding" qualities of the calibration. The receiver coils should be adjusted to permit oscillation with one setting of the regeneration control through the band to be calibrated. The regeneration control should have an indicating device on it to allow duplication of the original setting and a very small variable condenser, controllable from the panel, should be connected in shunt with the main tuning condenser. The capacity of the small variable should be sufficient to cover about ten degrees on the scale of the regular tuning condenser. No indicator is necessary as all the calibration work will be done on the main tuning condenser.

The calibration proper is accomplished in the following manner. First pick a Friday night when one of the A.R.R.L. standard frequency stations is going to be transmitting the altogether too-little-used standard frequency points. Allow plenty of time for the receiver to warm up (15 or 20 minutes) and then tune in several of the high power commercial stations that are on almost continuously. Set the small shunt condenser at half scale and tune one of the commercial stations to zero beat. Record accurately the setting of the tuning dial on this station and proceed to another one, repeating the operation and keeping an accurate record of the settings of the tuning dial. It can be seen readily that the frequency band should be in the center of the dial to allow for picking up these marker stations. A good plan is to have the band cover from 20 to 80 on a 100-division dial; this leaves the balance for the marker stations. Four or five markers are enough.

The first point of the standard frequency transmission should be logged in the same manner as the commercials and so on down the line, being sure to use only the tuning dial and also to get the standard frequency transmissions tuned into zero beat with the receiver. When the last point has been recorded carefully all the necessary values are known for plotting a curve on graph paper. If the frequencies of the marker stations are known they also can be added to the curve.

The receiver is completely calibrated now but we still haven't used that little condenser. Its function is to correct errors in the scale of the main tuning condenser. In other words, suppose WEE on the original set up came in at 94 but when a frequency check is wanted WEE happened to be coming in on 95. Set the main tuning

dial on 94 and then put WEE on zero beat by adjusting the small condenser, thus correcting any error that may have developed since the last time the receiver was used. After the marker station has been "put" it might be wise to run over the rest of the marker stations that happen to be on to see if they appear at their original dial settings. If they do — and they should — the receiver is ready for checking frequency. It is advisable to go back to the marker stations from time to time to make sure the calibration has not changed because of the apparatus "warming up." Also, discretion in selecting marker stations of good frequency stability is imperative.

This method of checking frequency has been in use at W9CWI for some time and has proved very reliable. It is possible to set the receiver for standard frequency transmissions and come to within 500 cycles of zero beat with them. It is also possible to set up on one of the marker stations and tune the others to zero beat on their specified dial readings.

— George Collier, W9CWI

This method of calibration is particularly applicable to battery-operated receivers, the tubes for which generally reach their final operating temperature very quickly. It is more difficult to get really good results with a.c. sets because variations in line voltage make accurate settings difficult because of frequency instability introduced by variations in the "B" supply voltage. — Editor.

Curing Parallax

USERS of the National Type B vernier dial should welcome this stunt for eliminating the parallax caused by the fact that the celluloid window on which the indicator line is engraved is some distance from the dial scale. The window furnished with the dial should be removed and a new one, cut from stiff celluloid as shown in Fig. 10, substituted. This has an "extension" which is tapered to a point and bent under, the point riding on the dial scale. For good visibility a little black ink should be put on the point. Be careful of the rivet when removing the old window.

The scratching noise in the receiver sometimes encountered when this type of dial is used on a metal panel is caused by the brass disc of the dial rubbing against the panel and can be cured by cutting out a disc of celluloid and gluing it to the back of the dial.

— Harry Hurley, W6CKS

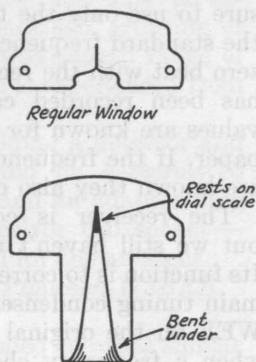


FIG. 10

Audio Selectivity — Alias Tone Control

MOST of us have heard of the indolent gentleman living under a leaky roof who remarked that when the sun was shining there was no need of worrying about the leak, and when it was raining it was too sloppy to go up and fix it.

So it is with audio selectivity. We can manage to get along without it when there are not too many stations on the air. But when the QRM sails in without warning, it is time to wish for something that we could twist and still follow that station who is rattling away in the bedlam, confident that we are copying everything.

There is something that we can do, and it is so overwhelmingly simple that the wonder of it is that all our receivers are not so equipped at the present time. It is nothing but a tone control such as our BCL friends have been using for the past two years.

A glance at Fig. 11 will convince anyone of the simplicity, and a trial on your own receiver will show the effectiveness. It can be attached to any receiver, regardless of the audio system used. There are no traps to build or inductances to calculate. The values of the two units, .01 μ fd. for the condenser and 100,000 ohms for the volume control, are average and will work well with

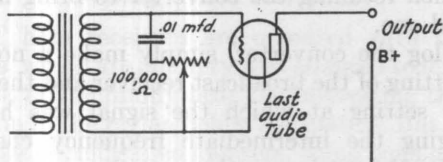


FIG. 11

all transformer coupled systems. With resistance coupling it may be necessary to use a higher value of resistance in the volume control. This refers to the last audio tube only; it does not matter what kind of coupling is used in the first audio.

The writer uses and recommends the type of audio system which gives good bass response. Use good quality transformers whether you intend to apply this tone control or not. A low or medium ratio is best. A medium or low-pitched tone works through noise and QRM better, even without a tone control, and with one the effect is very gratifying. With the growing use of crystals and d.c. signals trying to pick out one station from three or four on the same frequency with the same kind of whistling note is very confusing, and it is almost uncanny as you turn the tone control down toward the bass to hear the interfering stations on both sides gradually fade away, leaving the signal you want with nearly as much volume as before. Hardly less gratifying is the ability to soften the sharp discharges of static, and to minimize the roar of a power leak.

Try a tone control on your receiver, and give the other fellow's signals a chance.

— Alton H. Goud, W1CFO

Split-Stator Midget

ONE popular method of band-spreading in ham receivers calls for the use of a tuning condenser with two stationary-plate sections. The job of cutting the stator into two parts is easy if the condenser has supports for the stator in both front and rear, but if the whole assembly is supported from the front bearing plate it presents something of a problem. Here is a solution provided by Bill Best, W4ACQ, as applied to the Pilot midget.

The extra materials needed are a few short pieces of standard-size spaghetti and some insulating washers the same thickness as the regular brass spacing washers. Take off the plates that are to form the extra stator section (generally two plates will be enough) and ream out the holes

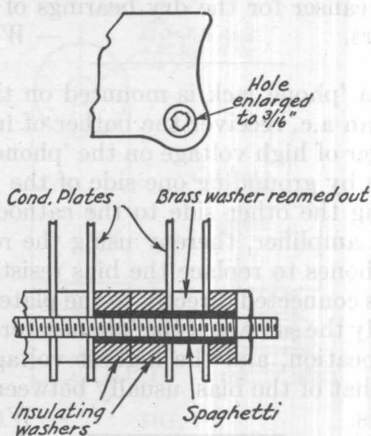


FIG. 12

to make them 3/16-inch in diameter. The insulating washers should also be reamed out to have the same size hole if not already drilled to the right size. Two of the regular spacing washers should also be reamed similarly. Then, leaving the rest of the condenser with its regular construction (using the right number of plates of course) slip a piece of spaghetti over each of the mounting bolts and assemble the new section as shown in Fig. 12. A soldering lug should be brought out from the insulated section for making external connections.

This scheme has given good service at W4ACQ, and has permitted the use of a small condenser in limited space.

A Hint for Reducing Noise Level

SOMETIMES it is possible to make relatively tremendous improvements in performance without spending a cent for additional equipment but just by using one's head. Here is some information from J. D. Blitch, W4IS, which nicely illustrates the point, and which incidentally may prove to be of assistance to 'phone operators who are having trouble with hum in speech amplifiers:

"An a.c. amplifier was designed to follow a battery operated pre-amplifier actuated by a

condenser mike. The amplifier was transformer coupled and used a 27 in the first stage and two 27's in push-pull in the second stage, high grade transformers being used. It was assembled on an iron chassis, and chokes, transformers, etc. were in iron cases. The filter consisted of an initial 10-henry choke followed by an 8-mike electrolytic, a 30-henry choke, and another 8 mikes as the termination. A 25,000-ohm filter resistor was inserted in series with the lead to the first audio B plus and a low hum level predicted.

"Measurements of hum were made with a rectifier voltmeter and 10,000 ohms connected to the two plates of the push-pull tubes. The initial measurements showed $1\frac{3}{4}$ volts as the hum level and as this amplifier was to be followed by another of some considerable gain, the result was not good enough. A little experiment showed that the principal hum was developed in the first stage and amplified through. And further, a listening test indicated that 60 cycles was the offending frequency. When the input (to the first tube) transformer was moved away from the power transformer the hum decreased but was still persistent to some extent at a distance of two feet. When it was returned to its original position near the power transformer it was found that it would actually take one-quarter of an inch of iron (thickness) to lower the hum level to the value obtained by isolation. This iron was used for magnetic shielding around the audio transformer, of course.

"About this time it was noticed that if the audio transformer was revolved slowly the hum level indicated by the needle would sink slowly to a value below that obtained by isolation or shielding and then rise again as the optimum position was passed. The point is that the mutual induction between power transformer and audio transformer can be made zero or any value desired by suitable positioning.

"To cut my story short the troublesome induction was utilized to buck the residual hum to a value several times lower than could be obtained by isolation of the transformer. To my surprise I obtained a total hum and noise level of one-tenth volt across the plates when the gain control was set at maximum and the condenser mike and preamp connected to the input, in a quiet, mid-night room! Compare this with the output level of 80-90 volts when the mike is whistled at rather faintly from across the room. The ratio of the power of the noise level to the power at full output is thus ridiculously low."

A Converter for the Ultra-High Frequencies

THE wiring diagram of Fig. 13 is that of a superhet converter for the 50-mc. region which, according to its designer, V. K. Hatfield, W6BXR is much superior to the usual super-regenerative receiver. The converter is used with a regular broadcast receiver.

The values given may require some modification for 5-meter work since the converter was built primarily to receive television signals broadcast from W6XS on 44.5 mc. Some idea of the changes that might have to be made to reach 56 mc. can be gained from the fact that 44.5 mc. is tuned in with the variable condensers set at about 75% of full capacity. Stray capacities play such an important part in the picture at ultra-high frequencies, however, that getting the right frequency range is almost certainly a matter for cut-and-try.

The coils are all wound on the same form, the spacing between L_2 and L_3 being about two inches. This provides sufficient coupling between the oscillator and detector. An alternative coupling scheme is to connect a 50- μ fd. condenser between

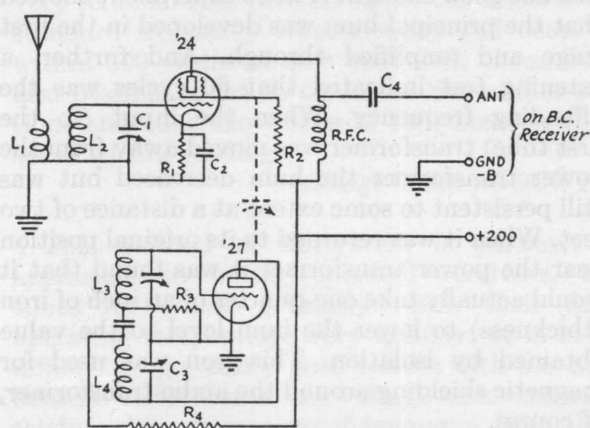


FIG. 13

CONVERTER CIRCUIT

- L_1 — 2 turns of No. 14 wire on half-inch diameter form.
- L_2 — 4 turns of No. 14 wire on half-inch diameter form.
- L_3 — 4 turns of No. 14 wire on half-inch diameter form.
- L_4 — 4 turns of No. 14 wire on half-inch diameter form.
- C_1 — Pilot 100- μ fd. midget with alternate plates removed.
- C_2 — .01 μ fd.
- C_3 — Hammarlund 100- μ fd. midget with stator split.
- C_4 — 250 μ fd.
- R_1 — 5000 ohms.
- R_2 — 250,000 ohms.
- R_3 — 15,000 ohms.
- R_4 — 25,000 ohms.
- RFC — Broadcast band r.f. choke.

the oscillator plate and detector screen-grid, as indicated in the dotted lines in the diagram. If this arrangement is used inductive coupling between the two tube circuits is unnecessary.

The metal ends of defunct Amperites make good caps for connection to screen-grid tubes. By cutting a few slices in the cap and then pinching the ends together with a pair of pliers it can be made to fit. Wire, lugs, binding posts or what have you may then be soldered on.

— C. R. Jacobson, Jasper, Alta.

A little suspected source of noise in receivers that use metal panels is the vernier dial with a disc at the back. Even though grounded, any rubbing between disc and panel will make a noise similar to condenser bearing QRN. The cure is to insert insulation between dial disc and panel. Celluloid or paper will work OK. — W6CKS

An aluminum pan makes a good solid chassis for a receiver and saves the trouble of cutting and assembling a sub-panel and braces.

— W1BBJ

Carbon tetrachloride, or Carbona, as well as being a good cleanser for crystals often will get that noise you can't clear up in your receiver. Apply it to the 'phone plug contacts and to the contacts of the 'phone jack itself. Then too it is a good cleanser for the dry bearings of variable condensers.

— W1ADF

When a 'phone jack is mounted on the metal panel of an a.c. receiver the bother of insulation and danger of high voltage on the 'phones can be overcome by grounding one side of the jack and connecting the other side to the cathode of the Type '27 amplifier, thereby using the resistance of the 'phones to replace the bias resistor. Plate voltage is connected directly to the plate. Results are exactly the same as if the 'phones were in their regular location, and the highest voltage across them is that of the bias, usually between six and nine volts.

— W2BYW

Good r.f. choke forms can be made from old adding machine tape spools, which are usually $\frac{3}{4}$ to one inch in diameter. A threaded bolt should be mounted in the chuck of a hand drill and the latter mounted in a vise. The spool is then fastened over the bolt with a washer and nut at each end. Hold a hack-saw blade on the spool and turn the drill, thus sawing a groove. This can be made as wide as necessary by holding the blade at an angle. A groove an eighth inch wide and the same deep will be about right, and three or four grooves about a quarter inch apart should be cut. Wind these full of No. 36 d.c.c. wire, starting at one end and continuing until all are full.

— W9GNV

W7ADU solved the problem of economically making 6-prong coils and sockets for his receiver. It was found that the "wafer" style of 5-prong socket had plenty of room in the center for mounting a G. R. jack, so a plug was mounted in the center of the bottom of a regular 5-prong coil form and the job was done.

TRANSMITTER SUGGESTIONS

Plug-In Transmitting Coils

THE usual method of mounting copper tubing transmitting coils on G.R.-type wall insulators by flattening and drilling the ends of the tubing is somewhat unsatisfactory in some respects. With the special bushing shown in Fig. 1, flattening and drilling of the coil ends is unnecessary.

The bushing is made of one-inch round brass stock, and is drilled and tapped on one end to fit the 10-32 screw furnished with the insulator. On the opposite end a slightly oversize quarter-

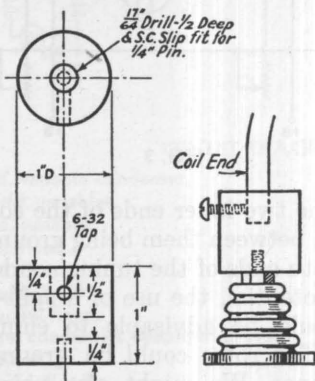


FIG. 1

inch hole is drilled to a depth of a half inch to make a slip fit for quarter-inch tubing. At right angles to this hole a third hole is drilled and tapped to take a 6-32 screw which acts as a set screw when the coil end is in place.

Using a bushing of this type coils can be changed rapidly and easily, with the certainty of always having good electrical contact.

— Harold V. Flood, Providence, R. I.

A Home-Made Neutralizing Condenser

MANY amateurs have encountered difficulty in obtaining adequate neutralizing condensers for their high-power transmitters. Either the condensers arced over or the insulation would go up in smoke. The solution of this problem is very simple. Each condenser consists of two rectangular 1½ by 2½-inch aluminum plates. The edges of each plate are well rounded and polished. They are mounted as shown in Fig. 2. Adjustment is secured by rotating the plates about their supporting insulators. The spacing is sufficient to withstand the combined plate and r.f. voltages usually encountered when using Type 852 tubes.

A Bias Problem Simplified

WE READ this letter from W6BPM with appreciation, having bumped into the same sort of

thing on the first m.o.p.a. we built. Voltage dividers are extremely useful, but they have one fault — the resistors in them insist on following Ohm's law whenever current is flowing through them. Here's W6BPM's story:

"In the following I hope to bring out a point that may have been overlooked and may help some brother out of the haze that also surrounded me and caused the old soldering iron to work overtime. Simple and fundamental though the point may be, its simplicity is its veil.

"I decided to return to the air, after a lapse of over a year, in true *QST* fashion, namely m.o.p.a. I built up a 210 self-excited oscillator with the conventional capacity coupling into a neutralized 75-watt stage; 400 volts to the oscillator, 2000 to the amplifier and the necessary 200 volts 'C' bias to get cut-off. I went through the necessary motions of tuning the oscillator, neutralizing and adjusting the amplifier, etc., so that the plate current of the amplifier was around 30 mils. All set now to couple the antenna, but try as I might I could not get the old milliammeter to go a speck over 50. Immediately I suspected the antenna, so up to the roof with a steel tape and checked all measurements O.K. Next, I suspected not enough excitation, but no, with 400 volts the excitation should be ample; anyway, I tried inductive

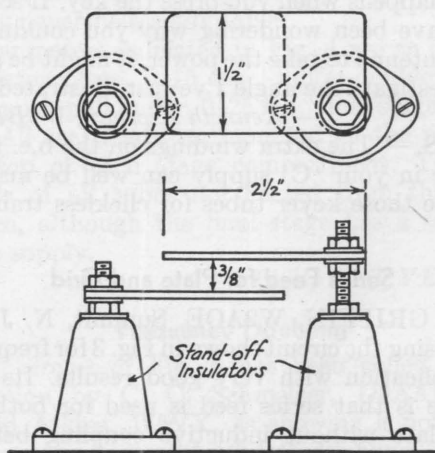


FIG. 2

NEUTRALIZING CONDENSER DETAILS

coupling, but the same results were had. M'gosh, what's wrong?

"At this point let me inject a more definite description of my power supply and maybe you fellows who are way ahead of me can see my dumbness and dismiss reading the rest of this.

The oscillator filament and power supply is entirely independent of the amplifier supply. The 'C' supply is independent of either, being made of modern b.c. power pack parts. The pack delivers 400+ volts and, as I only required 200, I nonchalantly hooked two 250,000-ohm resistors in series across the output, bringing the positive side to negative high-voltage and the midpoint (of the resistors) to the grid of the tube through the customary r.f. choke.

"To get back to the set, try as I might, putting r.f. chokes and what-nots all over the place I couldn't get the antenna to take any power. By accident I left a voltmeter across the 'C' supply while testing around, and was surprised to see the needle jump from 200 to well over the 450-volt mark, when the key was pressed. Well, I finally got to scratching the dome and what with picking the splinters out of my finger tips I saw light. That 250,000-ohm resistor was directly in series with the grid circuit and the grid current is in such a direction as to make the voltage drop across this resistance cumulative in effect with the 200 volts already available. (I realize the internal resistance of the meter made some difference, too.)

"Immediately, steps were taken to reduce the resistance (and, incidentally, their current carrying capacity increased), and boy, oh boy, the difference. With two 20,000-ohm units in series, the 'C' voltage fluctuates only slightly and I'm able to make the antenna pull the milliammeter anywhere from 30 to 200.

"Just for fun, some of you who are using b.c. equipment and voltage dividers in your 'C' supply, hang a voltmeter across the output and see what happens when you press the key. If some of you have been wondering why you couldn't get your antenna to take the power, it might be useful to investigate the angle I've just illustrated."

— *Kenneth Kiernan, W6BPM*

"P.S. — The extra windings on the b.c. transformer in your 'C' supply can well be made to operate those keyer tubes for clickless transmission."

Series Feed for Plate and Grid

D. A. GRIFFIN, W2AOE, Summit, N. J., has been using the circuit shown in Fig. 3 for frequency multiplication with very good results. Its chief feature is that series feed is used for both grid and plate without inductive coupling between stages, thus eliminating the necessity for any r.f. chokes in either circuit. The inductance is split into two parts, one half being in the plate circuit of one tube and the second in the grid circuit of the following tube. The tuning condenser is across the whole coil. The inner ends of the coil (those connected to the by-pass condenser) are at ground potential, and the plate and grid voltages are fed in at these points.

W2AOE has been using this scheme with

pentodes as frequency multipliers and states that a single pentode quadrupler working directly from a 3.5-mc. crystal oscillator has ample output to swing a neutralized Type '10 amplifier on 14 mc. The '10 is used to excite a Type '52 on the same frequency. The variable grid resistors allow adjustment of the bias to obtain maximum output when doubling frequency. Although not shown in this skeleton diagram, some fixed bias is also used.

A letter from Stacy W. Norman, W7OK, points out that a similar circuit is used in some of the Western Electric aircraft transmitters in the doubling stages. The only point of difference is that two by-pass condensers in series are used

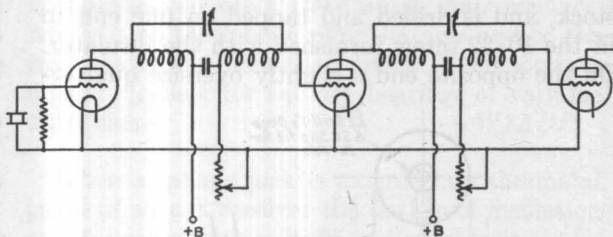


FIG. 3

between the two inner ends of the coil, the mid-connection between them being grounded.

Since both ends of the tuning condenser are at high r.f. potential, the use of a split-stator condenser would be advisable to eliminate hand capacity. The rotor could be grounded in the usual manner. We might also point out that neutralization of the amplifier or doubler can be accomplished very easily by connecting the neutralizing condenser between the plates of the two tubes. Since the r.f. voltages at the plate of the driver and the grid of the amplifier are 180 degrees out of phase, the correct phase relationship for neutralization will be secured by this simple method of connection.

An M.O.P.A. Transmitter Using Receiving Tubes

FOLLOWING is a description of a transmitter, using receiving-type tubes throughout, which has recently been put into service at VE3PN. As shown by the circuit diagram, Fig. 4, it consists of a series-feed Hartley oscillator using a Type 56 tube, a Type 24 buffer or doubler, a second buffer stage with a pair of 24's in push-pull, and a final stage with a pair of 46's in push-pull.

The box in which the transmitter is built is made of $\frac{3}{16}$ -inch aluminum and is 8 inches high by 24 inches wide by 10 inches deep. The panel is bakelite, 8 x 24 inches. The inside shelf on which tube sockets, coils, etc., are mounted is made from pieces of bakelite salvaged from the junkbox. It is mounted about $1\frac{3}{4}$ inches above the bottom of the cabinet. The oscillator is in the compartment at the extreme right, the other stages following in regular order to the left. All

tuning condensers and meters are mounted on the panel, as is also the keying jack, *J* in Fig. 4. Radio-frequency chokes, by-pass condensers and resistors are mounted below the shelf. The neutralizing condensers for the 46's in the last stage are Pilot midgets cut down to 4 rotor and 3 stator plates, double-spaced, and the neutralizing setting will be found to be at about half capacity.

the push-pull 24's approximately 20 ma. (both tubes) and the final stage between 110 and 130 ma.

The radio-frequency choke in the negative power-supply lead to the 46's, shown in Fig. 4, has been found necessary to prevent the final amplifier from reaction on the preceding stage. In this connection, it is also important that the shields between stages be continued below the

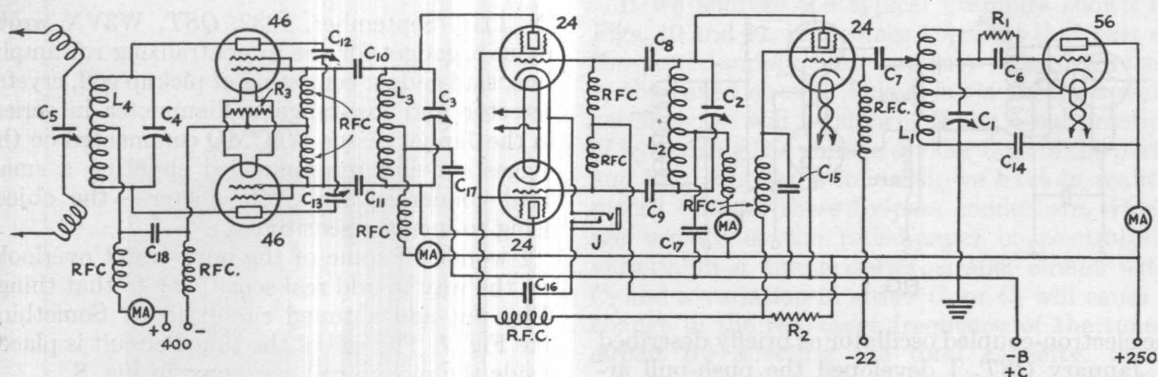


FIG. 4
CIRCUIT DIAGRAM OF VE3PN's M.O.P.A. TRANSMITTER

- C₁ — 500- μ fd. variable condenser.
- C₂₋₄ — 100- μ fd. variables.
- C₅ — 500- μ fd. variable.
- C₆ — 250- μ fd. fixed.
- C₇ — 500- μ fd. fixed.
- C₈₋₉ — 300- μ fd. fixed.
- C₁₀₋₁₁ — 250- μ fd. fixed.
- C₁₂₋₁₃ — Midget condensers described in text.
- C₁₄ — .1- μ fd. fixed.
- C₁₅₋₁₈ — .002- μ fd. fixed.

- R₁ — Variable grid leak (Pilot Resistograd).
- R₂ — 8600 ohms.
- R₃ — Center-tapped resistor, 20 ohms.
- L₁ — 5 turns No. 18 wire on 2-inch form.
- L_{2, L3} — Center-tapped coils wound on tube bases; 14 turns total for 7000 kc., 6 turns for 14,000 kc., both with No. 18 wire.
- L₄ — 12 turns copper tubing on 2½-inch diameter for 7000 kc., 6 turns same for 14,000 kc.
- J — Closed circuit jack.

The radio-frequency chokes in the transmitter are sectionalized affairs wound on slotted forms made from large-size wooden thread spools. The flanges at each end of the spool are turned down flush with the spool and four slots cut in at regular intervals. Each slot is ⅛-inch wide and ⅛-inch deep. The slots are wound full of No. 30 d.c.c. wire and the finished choke is then baked in wax. Regular manufactured chokes could be used instead, but these are inexpensive and easy to make if one has access to a wood-turning machine. R.f. chokes mounted near coils should be shielded; a simple shield made of tin foil has been found to be perfectly satisfactory for this purpose.

Tuning and adjustment of the transmitter are the same as with other oscillator-amplifier transmitters. Specifications are given for coils for the 7- and 14-mc. bands, the two in which VE3PN is chiefly interested. Suggested specifications for 3.5 mc. would be: for *L*₁, 12 turns similar to the 5 turns for 7 mc.; for *L*₂ and *L*₃, 30 turns, center-tapped, on tube bases; for *L*₄, 20 turns No. 12 wire wound on a 2½-inch form of sufficient length to mount in the same way as the copper-tubing coils for the higher-frequency bands. The 56 oscillator will draw about 12 milliamperes under load; the 24 buffer-doubler takes about 8 ma.,

shelf, particularly between the last two stages. Shielding between the oscillator and buffer-doubler does not seem to be absolutely necessary, but is nevertheless advisable.

The meters indicated in Fig. 4 are as follows: oscillator plate, 0–15 ma., buffer-doubler, 0–15 ma., push-pull buffer, 0–25 ma., final stage, 0–200 ma. All are Readrites, mounted on the panel at the top of each stage compartment. The filaments of all tubes are heated from the same source, although the final stage has a separate plate supply.

— Philip Neil, VE3PN

Frequency Doubling

THE circuit of Fig. 5 has been called to our attention by C. C. Schmelzer, D4AAR, and David Atkins, W6VX, as showing a noticeable improvement over the usual doubling circuits. The circuit is not a new development, although possibly not many amateurs have become acquainted with it. The grids of the two doubling tubes are fed in push-pull, the plates being connected in parallel. It is well known that in the ordinary push-pull circuit the second harmonic is balanced out in the output circuit proper, but flows back to the filament via the plate supply tap at the center of the output coil. In Fig. 5 the out-

put tank circuit is connected in the circuit in such a way as to trap the harmonic.

Push-Pull Electron-Coupled Oscillators

THE following dope from Ross Jones, W8SA, should be of interest to experimenters who have worked with the electron-coupled oscillator described by J. B. Dow in January, 1932 *QST*:

"Experimenting along the lines suggested by

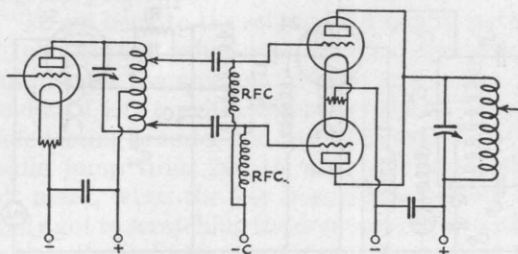


FIG. 5

the electron-coupled oscillator as briefly described in January *QST*, I developed the push-pull arrangement as shown in Fig. 6.

"This arrangement is by far the steadiest self-controlled oscillator I have ever worked. A change in plate voltage of approximately 40% made but a scarcely discernible change in the frequency as checked by beat note against my receiver. The heating of the plate has no apparent effect on the frequency, and since the cathode is at a relatively high temperature while in operation a frequency change due to the heating of the tube elements is not discernible after a moment's operation. However there is some change in frequency when circuit $L_2 - C_2$ is tuned to resonance with $L_1 - C_1$. This is not so apparent when $L_2 - C_2$ is tuned to a harmonic of $L_1 - C_1$.

"I am sure that there are many others, like myself, not in circumstances to afford expensive fre-

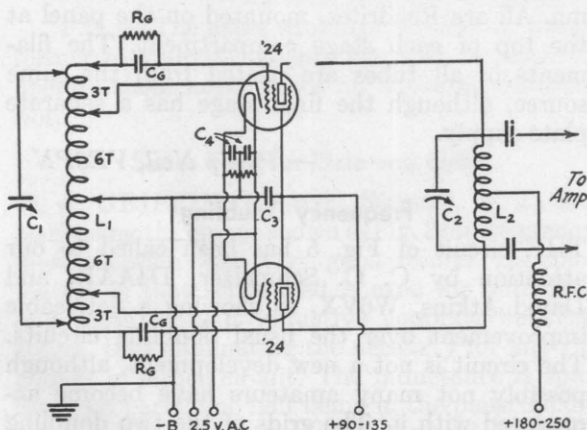


FIG. 6

PUSH-PULL ELECTRON-COUPLED OSCILLATOR

- L_1 — 18 turns on 2-inch form, tapped as indicated.
- L_2 — 10 turns same tapped at center.
- C_1, C_2 — 350 $\mu\text{fd.}$
- C_3 — .5 $\mu\text{fd.}$
- C_4 — .002 $\mu\text{fd.}$
- C_g — 250 $\mu\text{fd.}$
- R — 50,000 ohms.

quency control apparatus, who will be interested in the development of an oscillator of this sort."

Experiments with the single-tube electron-coupled oscillator in the *QST* laboratory fully bear out W8SA's experiences as well as the author's claims for the circuit. This type of oscillator undoubtedly is going to have wide application in amateur work.

A Tuned Pick-Up

IN THE September, 1932, *QST*, W3VX wrote about a gadget for use in neutralizing r.f. amplifiers, said gadget consisting of pickup coil, crystal detector and low-range milliammeter in series. In the January issue W6CMQ commented on the suggestion and recommended shunting a small fixed condenser across the meter — the object being to increase sensitivity.

I wonder if some of the boys aren't overlooking the way to add real sensitivity to that thing? Why not add a tuned circuit to it? Something like Fig. 7. The coil of the tuned circuit is placed inside the pickup coil, as shown in Fig. 8.

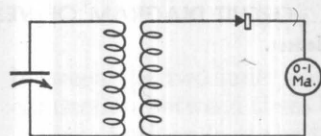


FIG. 7

This little piece of apparatus has been one of the most useful things around my shack for over three years, and deserves a better job than I have made of it. A very fine little article was written about it by Dr. Woodruff, and may be found in May, 1928, *QST*, page 39. It will be seen that my gadget is part of his "Combination Fieldmeter, Wavemeter and Voltmeter."

After reading Dr. Woodruff's article I made great haste in constructing this much of his "Combination," and that is one thing around here that has survived. I don't see how I could keep house (or shack) without it. The coils for the tuned circuit are of the plug-in variety, the two shown in the photograph being for 20 and 40 meters. The pick-up coil is simply three turns of bell-wire held together with string — *a la* Woodruff. It will be seen that I use a vernier condenser for tuning. That is not necessary. I used it simply because I had it; a little relic from the year 1.

— C. W. Norder, W8ALH

Amplifier Coupling

IN RADIO-FREQUENCY power amplifier operation ample grid excitation to any tube is an essential factor for proper operation. Yet, if the preceding tube is larger than necessary all of the power over that actually needed to swing the grid of the following tube is wasted.

There are occasional instances when one tube is not quite large enough to supply the necessary grid power to excite adequately the following tube. While two tubes of the same type would do the work nicely, many of us hesitate to put two

tubes of any type in parallel at the higher frequencies on account of the increased tube capacities and the possibilities of parasitic oscillations.

We can illustrate the above by taking the case of a c.w. transmitter utilizing a 204-A in the final power amplifier stage. Let us assume that the only tubes on hand are 210's. One tube alone will hardly give enough power to excite the 204-A

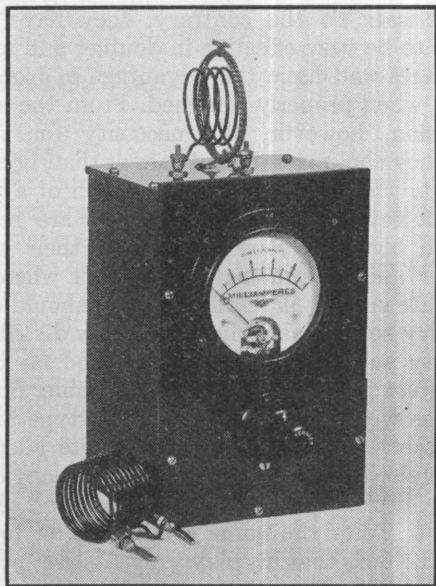


FIG. 8

A TUNED R.F. PICKUP USING A CRYSTAL DETECTOR AND D.C. MILLIAMMETER

fully. However, two 210 tubes will just about do the work efficiently.

The only alternative to parallel operation is to use push-pull. But here is the snag in the problem: the push-pull output stage must work into a single-ended amplifier using a relatively high-power tube. The circuit shown in Fig. 9 is a very simple solution. Inductive coupling between amplifier stages is nothing new, but its application in this instance may not be familiar to all amateurs.

The circuit shown is very easy to make work, and while the illustration deals specifically with 210's and a 204-A, many other tube combinations suggest themselves. The circuit may be used whether the final amplifier is a straight r.f. amplifier for c.w. or a linear amplifier in a radio-telephone transmitter. This circuit will prove particularly effective on the 7000- and 14,000-kc. bands.

— Everett L. Dillard, W9BKO

Some By-Passing Pointers

DURING the past year the use of circuits which supposedly do not require the radio-frequency chokes has become quite prevalent. Many of these so-called "balanced" circuits, while quite commendable from the standpoint of electrical symmetry, introduce irregular effects which if not taken into consideration cause two specific

types of trouble. These are often entirely overlooked because of the belief that the circuit is immune from the ills of stray radio-frequency paths.

Generally, this trouble pertains only to circuits in which a fixed mica condenser or condensers are inserted in series with and in the electrical center of a tank inductance to allow bias and plate potentials to be fed in at the voltage node.

If we analyze the typical examples shown in Figs. 10 and 11, it becomes apparent that part of the power-supply filter capacity is incorporated in the tuned circuit. This is not a theory but an actuality, as will be shown. If the usual practice of by-passing the voltage divider taps in the plate and bias supplies is followed, we have in reality placed both of these by-pass condensers, which are usually of the rolled-paper or electrolytic variety, in a simple series-parallel circuit with C_3 and a variation in either C_1 or C_2 will cause a change in the resonance frequency of the tuned circuit by affecting the total capacity. Since paper and electrolytic condensers, especially those of high capacity, show constant small variations in capacity with changing voltages, we can expect variations in the tuned circuit to result. These variations take two forms; first, the occasional change in the tuned circuit which would seriously affect the stability of a self-excited oscillator and cause lowered efficiency in crystal-controlled rigs. It may be said here that some forms of split Hartley and Colpitts oscillator circuits are prone to this effect, especially if an un-needed grid condenser should inadvertently be placed in the circuit or if a split-stator tank condenser with the rotor grounded should be used.

The second form, which is even more important since its source is not apparent, is slight modulation of the tuned circuit, the effect of which is quite appreciable when occurring in the first doubler or amplifier stage. In a broadcast-frequency signal generator which was built here using a split Colpitts circuit with a split-stator tank condenser a noticeable hum on resonance was found which disappeared when a battery-operated signal generator was used, thereby eliminating the receiver as the source. The power

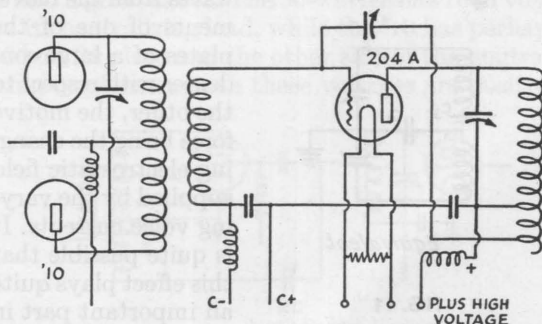


FIG. 9

INDUCTIVE COUPLING BETWEEN A PUSH-PULL EXCITER AND SINGLE-ENDED AMPLIFIER

oscillator. The rather high bias on the multiplier cuts off the plate current there, so long as the grid is not excited, and as a result this tube might just as well be left in the socket.

The grid blocking condensers are placed as shown to keep the high d.c. voltage away from the switch.

— Henry S. Keen, W2CTK

Combined Oscillator and Doubler

MANY amateurs who wish to use crystal control on the 7- and 14-mc. bands have difficulty in multiplying the 3.5-mc. crystal frequency for work in the higher bands, especially when the cost of the set must be kept down. In the course of experimenting with many types of doubling equipment I have arrived at the circuit arrangement of Fig. 13, which gives very good results with a minimum of parts.

Either a 46 or '47 can be used in this circuit. The oscillator tank is placed in the screen grid of the '47 or outer grid of the 46, and this much of the circuit performs just like any other crystal oscillator. The tank in the plate circuit is tuned to twice the crystal frequency, and is adjusted for the dip in plate current in just the same way as the ordinary amplifier or doubler. The values are not critical. At the voltages shown an output of about 5 watts is obtainable on 7 mc.

In actual operation the '47 is superior to the 46. With the '47 the plate current is 18 to 20 milliamperes, with an r.f. crystal current of 20 mils, while the 46 draws 35 to 40 milliamperes with a crystal current of about 60 mils. The output is the same in both cases. If the voltage applied to the screen grid is too great the grid will overheat, and when this happens the circuit will not start up again after the power has once been turned off.

Using this circuit and a second doubler of the ordinary type with a 46 tube, the output on 14 mc. is great enough to make a Type '10 draw 20 to 25 mils grid current. The results using the oscillator as a quadrupler have not been so good, since the output is only sufficient to excite a 46 tube to about 5 watts output.

For 3.5-mc. operation the tank in the screen-grid circuit is shorted out and a 3.5-mc. coil plugged in the plate circuit, changing the circuit to that of the regular pentode crystal oscillator.

— William P. Durkin, W2DHM

A Neutralizing Kink

GENERALLY the greatest trouble experienced in high-power amplifiers after neutralization is from continual breakdown of the neutralizing condenser unless it is rated at twice the plate voltage or so. The following trick was hit upon at W2ZC and saved expensive neutralization con-

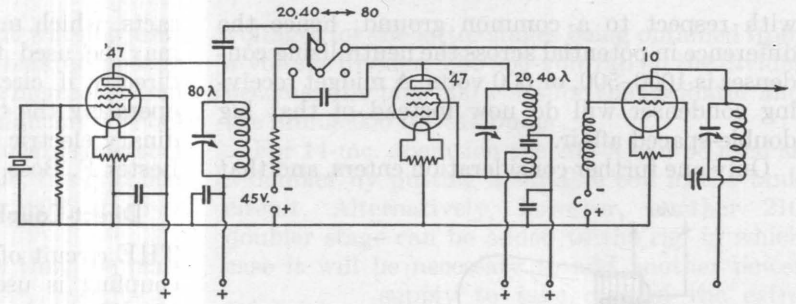


FIG. 12

A THREE-BAND CRYSTAL-CONTROLLED TRANSMITTER USING THE "POWER-TYPE" MULTIPLIER

densers for the 500-watt stage and works beautifully.

The neutralizing condenser is connected to preceding amplifier side of the grid condenser, as shown in Fig. 14, instead of the old method of go-

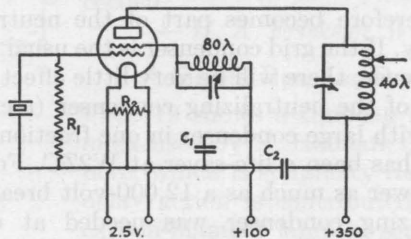


FIG. 13

COMBINED OSCILLATOR AND DOUBLER

R_1 — 100,000 ohms.

R_2 — 20 ohms, center-tapped.

C_1, C_2 — .25 μ fd.

Tank circuit combinations are any which will tune to the respective frequencies, preferably low-C.

ing directly to the grid. It is often common practice to run the last two stages from the same supply or at approximately the same voltage, and with this method the neutralizing condenser has no d.c. difference in potential across it. With the 852-204-A combination it is possible to use a neutralizing condenser of low breakdown voltage-rating. With the old method such a combination required a 6000-volt neutralizing condenser at W2ZC to hold down the voltage.

As applied to smaller transmitters, for instance with a Type '10 feeding a 50-watter, this method is also a great saver. The 50-watter has 1000 volts on its neutralizing lead, while the '10 has perhaps 500 on its plate and the other side of the neutralizing condenser. Both these voltages are positive

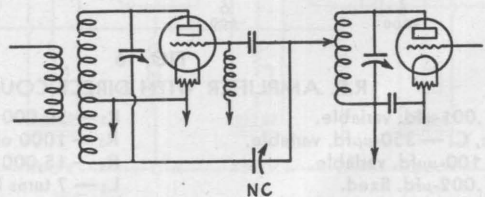


FIG. 14

A NEUTRALIZING CIRCUIT WHICH MINIMIZES VOLTAGE BREAKDOWN

with respect to a common ground; hence the difference in potential across the neutralizing condenser is 1000–500, or 500 volts. A midget receiving condenser will do now instead of that big double-spaced affair.

Only one further consideration enters, and that

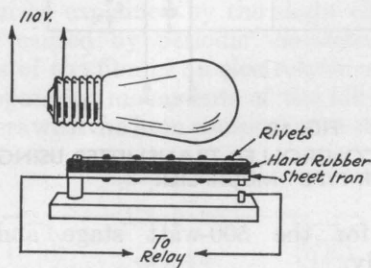


FIG. 15

can be quickly discounted. The grid coupling condenser is in series with the neutralizing condenser and therefore becomes part of the neutralizing capacity. If the grid condenser is the usual .002 or so, however, there will be very little effect on the setting of the neutralizing condenser (reciprocal sums, with large condenser in one fraction).

This has been a life-saver at W2ZC. For very high power as much as a 12,000-volt breakdown neutralizing condenser was needed at certain times. Now a very insignificant condenser sits serenely in the final stage and doesn't turn a hair.

— H. B. Churchill, W2ZC

An Inexpensive Time-Delay Switch

FIG. 15 shows a method of making a time-delay switch utilizing a home-made thermostat made from strips of hard rubber and sheet iron riveted together. The difference in the expansion coefficients of the two materials causes the riveted strip to bend when heated, thus closing the con-

tacts, which may close the circuit to a relay or may be used to operate the controlled circuit directly if circumstances permit. The heat for operating the thermostat is furnished by an ordinary electric lamp. This stunt is suggested by Lester F. Boss, W1AXM.

Direct-Coupled Amplifiers in the Transmitter

THE circuit of Fig. 16 is unusual in that direct coupling is used between the buffer and final amplifier somewhat in the style of the Loftin-White audio system.

The oscillator is a high-*C* Hartley with a Type '45 tube, shunt fed. It is coupled to the buffer, another '45, with series grid feed. Separate filament supplies for each of these tubes permit the use of resistor R_3 to provide grid bias for the buffer tube. The oscillator works permanently on the 3500-kc. band, the buffer tank coil being changed for either 3500- or 7000-kc. work. A 200-volt power supply handles both these tubes.

As Fig. 16 shows, the grid of the final amplifier, a Type '10, is coupled directly to the plate tank coil of the buffer, which places the buffer plate voltage right on the amplifier grid. The bias on the grid of the amplifier is not positive, however, because the filament is supplied from a separate source and the 600-volt power supply which furnishes plate current for the amplifier is well insulated from the negative side of the 200-volt supply. Thus there is series feed on both the buffer plate and the amplifier grid. The remaining points about the circuit should require little comment.

Tuning and operation should be about the same as with other circuits. W9EVI tried using a 45-volt battery as bias on the final amplifier, in addition to the 15,000-ohm grid leak, but found that the latter alone gave about the same results.

Inputs as high as 50 watts have been used on the amplifier, with good r.f. output to the antenna. The signal from the rig is nearly always reported "crystal d.c."

Although not shown in the diagram, it is probable that the buffer tube will require neutralization when operating on 3500 kc.

Fig. 17 shows a more highly developed transmitter using a 210 crystal oscillator, 210 intermediate stage and a 203-A final amplifier. The resistors marked R_2 and R_3 automatically control the grid bias on each stage by the flow of plate current, in the same way that cathode resistors are used to obtain bias in receiving sets. If the excitation should be cut

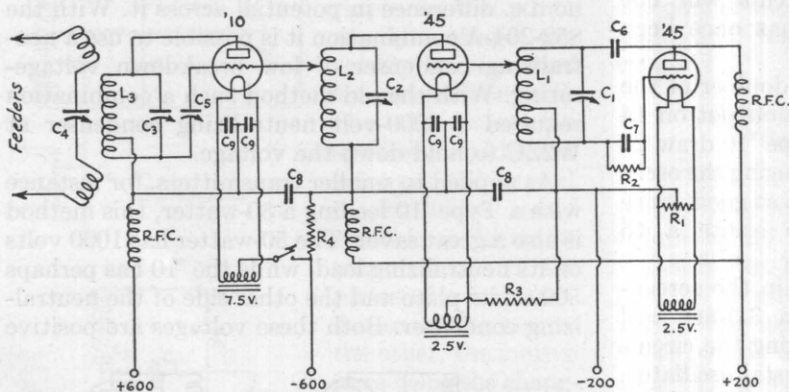


FIG. 16

R.F. AMPLIFIER WITH DIRECT COUPLING

C_1 — .001- μ fd. variable.
 C_2, C_3, C_4 — 350- μ fd. variable.
 C_5 — 100- μ fd. variable.
 C_6 — .002- μ fd. fixed.
 C_7 — 250- μ fd. fixed.
 C_8, C_9 — .002- μ fd. fixed.
 R_1 — 20-ohm c. t. resistor.

R_2 — 50,000 ohms.
 R_3 — 1000 ohms.
 R_4 — 15,000 ohms.
 L_1 — 7 turns No. 8 wire on 3-inch dia.
 L_2 — 12 turns same.
 L_3 — 14 turns copper tubing, 3-inch dia.

The coil specifications are for 3500-kc.

off from one stage its plate current will not jump up as it does with simple grid leak bias, because an increase in plate current causes an increase in bias so that the system becomes self-balancing without damage to the tube if the right values of resistance are used. If R_2 and R_3 are variable, the grid bias can be adjusted individually for each stage to obtain maximum efficiency.

It is evident from the diagram that the plate

voltages for the latter stages being obtained from a voltage divider. The 300-volt tap on the divider becomes the plus 300 volts for the oscillator and the minus 600 for the buffer.

For 14-mc. operation the 203-A can be used as a doubler by putting a suitable coil in the tank circuit. Alternatively, however, another 210 doubler stage can be added to the rig, in which case it will be necessary to add another power supply to take care of the extra tube. Fig. 18 shows schematically how this can be done with 210's. The same circuit diagram will apply if a 203-A is used in the output stage, although the voltages on the tubes should be adjusted to suit the changed conditions. While operating on 14-mc. the plate voltage recommended should not be exceeded.

— H. A. Erickson, W9EVI

A Simple Time-Lag Device

FIG. 19 shows a time-lag arrangement used by N. Holman, of Singapore, which is simplicity itself. The delay action is contributed by the carbon-filament lamp in series with the relay, and the time can be varied by adjusting the tension of the relay armature spring and by the setting of the 50-ohm variable resistor. The delay is obtained by virtue of the fact that carbon has a negative temperature coefficient of resistance, so that the relay current is small when the circuit is closed and increases to a value which will operate the armature when the lamp filament gets hot.

Naturally the size lamp required will depend on the current needed to operate the relay. Holman's juice is 110 volts d.c., which of course means that a d.c. relay will work OK. An a.c. relay can be used with a.c. supply. The device is sensitive to external temperature, which makes it

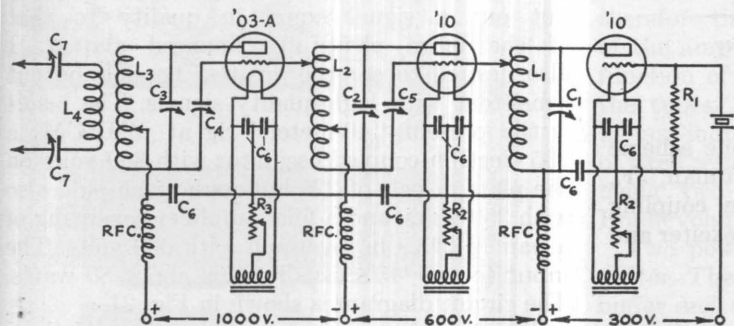


FIG. 17

CRYSTAL CONTROL WITH DIRECT-COUPLED AMPLIFIERS

- C_1, C_2 — 500- μ fd. variable condenser.
- C_3 — 440- μ fd. transmitting condenser.
- C_4 — 100- μ fd. transmitting condenser.
- C_5 — 100- μ fd. receiving condenser.
- C_6 — .002- μ fd. 5000-volt condensers.
- C_7 — 350- μ fd. variable condenser.
- R_1 — 10,000 ohms.
- R_2 — 1000 ohms, variable, 50-ma. rating.
- R_3 — 1000 ohms, variable, 150-ma. rating.
- L_1 — 12 turns $\frac{1}{8}$ " copper tubing on 3-inch diameter.
- L_2 — 12 turns $\frac{1}{8}$ " copper tubing on 3-inch diameter for 3500 kc.
6 turns same for 7000 kc.
- L_3 — 14 turns $\frac{1}{4}$ " copper tubing on 3-inch diameter for 3500 kc.
7 turns same for 7000 kc.
- L_4 — 6 turns $\frac{1}{4}$ " copper tubing on 3-inch diameter.

voltages from one stage to the next add up. The total voltage from the oscillator minus B to the plus 1000 volts on the final amplifier is 1900 volts. The filament transformers should be well insulated, and all of the blocking condensers should be of the 5000-volt transmitting type for protection against puncture by the plate voltage. If good quality parts are used throughout there should be no trouble in operating the rig, since it is adjusted in just the same way as the usual multi-stage transmitter.

Each stage should have its own plate supply, although two will be sufficient if both have approximately 1000-volt output. In this case one would be used for the amplifier and the other for the intermediate stage and oscillator, the proper

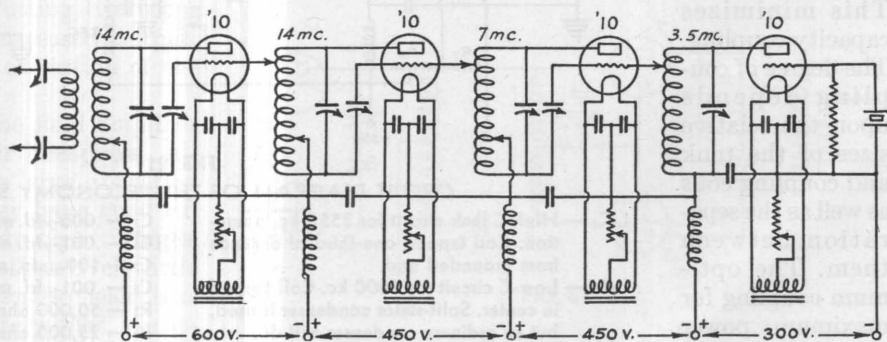


FIG. 18

A DIRECT-COUPLED CIRCUIT FOR 14-MC. OPERATION

A tube of greater power rating than the last Type '10 can be substituted and the plate voltage raised accordingly.

necessary to readjust the variable resistor occasionally.

Link Coupling

MANY methods have been devised for coupling single-ended exciting amplifiers or oscillators to

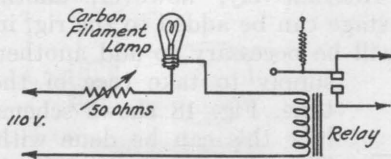


FIG. 19

push-pull amplifiers. Fig. 20 shows one scheme for this purpose used by G. R. Boardman, Jr., W8ME. Besides taking care of the coupling difficulties, it makes it possible for the exciter and

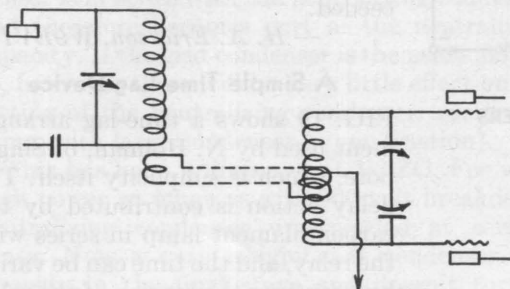


FIG. 20

push-pull amplifier to be located at some distance from each other, although the tuning apparatus for both stages can be placed close to the respective tubes.

The coupling loop is simply a turn or two of wire closely coupled to the tank coil at a point of low r.f. potential.

Couple to the end opposite the plate on a single-ended amplifier, and at the center of the tank coil on a push-pull stage. This minimizes capacity coupling. The degree of coupling depends upon the relative sizes of the tank and coupling coils as well as the separation between them. The optimum coupling for maximum power transfer can be readily ascertained after a little experiment-

ing. The transmission line can be any convenient length — several feet if necessary — without appreciable loss of power.

An Inexpensive Transmitter with Electron-Coupled Oscillator

FOR some time the writer has been working with the electron-coupled oscillator in an effort to probe its possibilities. It appeared to me to offer the fellow who is short on cash an opportunity to put out a signal equal in quality to that of the more plentifully financed station. I also desired to get the greatest possible output consistent with high-quality signals. The result is the present "40-meter" rig at W9HCM: a 235 electron-coupled oscillator with 350 volts on the plate, a pair of 224 buffers in push-pull, also with 350 volts, and a final amplifier consisting of a pair of 245's in push-pull with 600 volts. The input to the '45's usually runs about 80 watts. The circuit diagram is shown in Fig. 21.

The layout used is an arrangement of three shelves, supported by wooden uprights at each corner, as shown in the photograph. Since the rig was built experimentally, it was put together with an eye to electrical efficiency rather than beauty, and as a result does not in the least resemble anything turned out by W. E. The lower shelf contains the electron-coupled oscillator; on the second is the buffer amplifier and also a home-made filament transformer which lights the three screen-grid tubes. The power amplifier — which, by the way, is nothing more or less than the old push-pull '45 rig of November, 1930, *QST*, neutralized and arranged for external excitation — occupies the top shelf. This should be a tip to those who, having built this popular outfit, wish to increase its output and at the same time im-

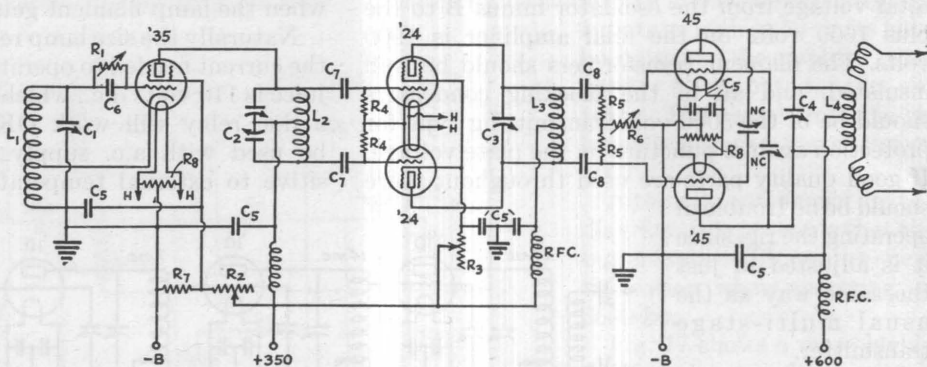


FIG. 21

CIRCUIT DIAGRAM OF THE "ECONOMY SPECIAL"

- L₁C₁ — High-C tank circuit for 3550-kc. operation. Coil tapped one-third of distance from grounded end.
- L₂C₂ — Low-C circuit for 7000 kc. Coil tapped in center. Split-stator condenser is used, but an ordinary condenser will do.
- L₃C₃ — Usual for 7000 kc., fairly low-C.
- L₄C₄ — Same as L₃C₃. If the final stage is made from the November, 1930, *QST*, transmitter, as is W9HCM, L₄ may be the 3500-kc. tank coil.

- C₅ — .006- μ fd. mica condenser.
- C₆ — .001- μ fd. mica condenser.
- C₇ — 100- μ fd. mica condenser.
- C₈ — .001- μ fd. mica condenser.
- R₁ — 50,000 ohms.
- R₂ — 25,000 ohms, variable.
- R₃ — 20,000 ohms, variable.
- R₄ — 15,000 ohms, 2-watt rod-type resistor.
- R₅ — 50,000 ohms, 2-watt rod-type resistor.
- R₆ — 25,000 ohms, variable (Bradleyohm).
- R₇ — 20,000 ohms.

prove signal quality. Conversion of the old PP-TNT to m.o.p.a. practically doubled its output at the same plate voltage.

Now for a few operating hints. It is important to have low- C in the oscillator output tank circuit, since the ratio of L to C has a marked effect upon the output and should be kept as high as

adjusted for maximum efficiency. The variable resistor R_6 is an important adjustment in getting good efficiency from the output stage.

A feature of the transmitter which probably will draw gasps of horror from conventional-minded hams is the omission of r.f. chokes from the grid circuits. However, after a day of winding different kinds of chokes I found that arranging the grid resistors as shown gave better results than the best choke I had succeeded in winding; therefore there are no chokes in the grid circuits of the amplifiers. The resistors have the double function of keeping r.f. in its place and biasing the tubes. It is important that these resistors be non-inductive, however. The carbon-rod type of fixed resistor is satisfactory, the rating of each being two watts. The variable resistors are Bradleyohms.

Two power supplies are used with the transmitter. The low-voltage power pack supplies the buffer and oscillator. The final amplifier gets its power from a separate supply. Although the tubes undoubtedly are overloaded, judging by the manufacturers' ratings, nevertheless there isn't a plate in the whole rig that shows the faintest blush. Reports are always d.c. or p.d.c., and over 75% of them are "crystal." I might add that this same pair of '45's has been laboring under 600 volts for about a year and both tubes test OK. This outfit is giving me more good signal per dollar than anything I have ever built.

— Winston Bull, W9HCM

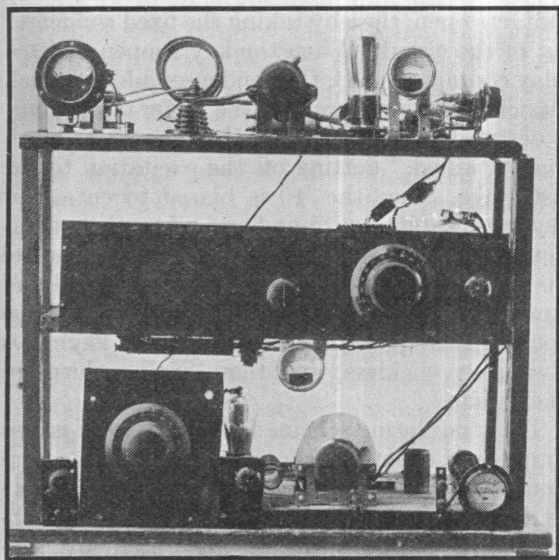


FIG. 22

W9HCM'S TRANSMITTER

The electron-coupled oscillator occupies the lowest shelf; the buffer amplifier with two '24's in push-pull is in the middle, and the final amplifier is on top. The '45's in the last stage handle 80 watts without difficulty, and the signals are nearly always reported "crystal."

possible. When adjusting the oscillator for maximum output the indicating device should be coupled to the output tank and not to the oscillator circuit itself, because an adjustment which increases the r.f. energy in the oscillator tank often has the opposite effect on the output circuit.

The buffer stage is used because the output of the electron-coupled oscillator is not great enough to excite the '45's directly. The '24's are used in it because they are easy to excite and because they require no neutralizing. Putting two tubes in push-pull makes for increased output, cooler tubes and uniform excitation of the following stage.

The '45's are used in the final amplifier primarily because of their cheapness. Although these tubes require large excitation voltage and high bias, they have good r.f. output and will stand fairly high voltages. The high bias required is of relatively little consequence, however, because leak bias is just as efficient as battery bias, consequently no batteries are used. When adjusting an amplifier circuit in which resistor bias is used, no attempt should be made to get "cut-off." Instead, excitation is applied and the bias resistor

A Pinch-Hitting Neutralizing Stunt

IT IS not generally known that in circuits with symmetrical input and output (push-pull) neutralizing may be accomplished with a single condenser, as shown in Fig. 23. Inspection of the diagram will show that T1 is grid-neutralized, while T2 is plate-neutralized. Since this slightly unbalances the input, it may be necessary to compensate for the unbalance by shifting the grid center-tap (or plate tap of the preceding stage), or by adding a small capacity to the side of the input circuit as shown by the dotted lines.

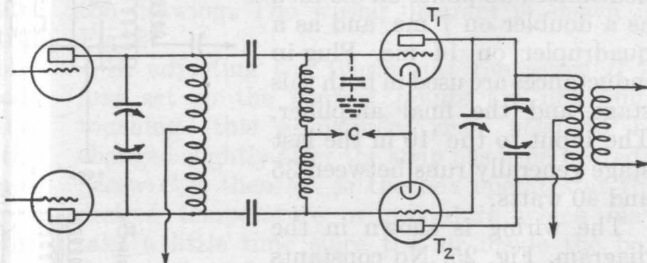


FIG. 23

This stunt saved the day when only a single neutralizing condenser was available for an experimental push-pull amplifier.

— Frank J. Burris, W9EBG

A Handy Test Lamp

A USEFUL refinement for the ordinary flashlight lamp and loop so universally used for neutralizing and checking oscillation is illustrated in Fig. 24. The idea originated with T. S. Shaw, W6AVN. A wooden clothespin of the spring type serves as a holder for the usual lamp and wire loop and also

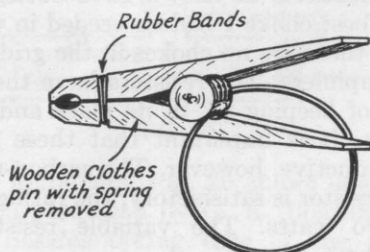


FIG. 24

as a clip to be snapped on a copper-tubing inductance. The coupling between the loop and the tank coil can be adjusted very readily — and will stay put — if the nose of the clothespin is carved down to a short stub as shown in the drawing. Besides keeping the coupling fixed at the value considered most desirable, both hands are free for the tuning operations.

A Transmitter With Unusual Features

HERE is a brief description of a transmitter that has given exceptional satisfaction for a low-power job, and in which there are two or three details that differ enough from ordinary practice to be of possible help to others.

The set is an m.o.p.a., using a '47 pentode Hartley oscillator, a '47 buffer, and a Type '10 final amplifier. It is used for c.w. work on the 3.5-, 7- and 14-mc. bands, and for 'phone on 3.5 and 14 mc. The oscillator is set permanently on 3500 kc., regardless of the band on which the final amplifier works — a stunt which helps greatly in maintaining a very clean and stable signal from the oscillator. The buffer stage works as a straight-through neutralized amplifier on 3.5 mc., as a doubler on 7 mc. and as a quadrupler on 14 mc. Plug-in inductances are used in both this stage and the final amplifier. The input to the '10 in the last stage generally runs between 35 and 40 watts.

The wiring is shown in the diagram, Fig. 25. No constants are given, since the sizes of coils, condensers, etc., do not differ from those used with other sets of similar nature. The oscillator tank circuit should be High- C , of course, but it is best

to use a fairly high ratio of L to C in the other two stages.

One of the unique points about the transmitter is the keying system. A .001- μ fd. fixed condenser is connected across the tank tuning condenser of the buffer stage, in series with the keying relay, the contacts of which are normally closed (back-contact relay). When the key is pressed the relay contacts open, thereby taking the fixed condenser out of the circuit. When the key is open and the relay contacts closed, the condenser adds so much capacity to the system that the buffer tank circuit is detuned, with the result that the r.f. is effectively "killed," cutting off the excitation to the last stage. Since the '10 is biased to cut-off or beyond, no plate current flows when the excitation is cut off. The advantages of this scheme are that it permits full break-in operation on 14 and 7 mc., and break-in within a few kilocycles of the operating frequency on 3.5 mc.; the keying is absolutely clickless; and there are no chirps or back-wave.¹

The modulating scheme for 'phone work is also simple and effective, a form of grid-bias modulation being used in which the modulator tube acts as a variable grid leak for the modulated amplifier. This arrangement is also used by several other 14-mc. 'phones, including W5AEJ, W5BRD, W5GA, W8CPC, W8CKC and others. The modulator tube is a Type '01-A. No speech amplifier is necessary.

Resistance bias is used throughout the trans-

¹ This method of keying is subject to one disadvantage — the plate current on the tube being keyed will rise to values which may be abnormal when the tank circuit is detuned if the excitation from the preceding amplifier is large. So long as this "detuned" plate current is not much greater than the rated plate current for the tube no damage will be done to receiving types such as the '47 and '45, at normal plate voltages. With thoriated-filament tubes such as the Type '10, however, the filament is likely to be deactivated rapidly, even though the "detuned" plate current does not exceed the 60-mil oscillator rating. Oxide-coated filament '10's will be less subject to loss of emission under the same conditions.

— Editor

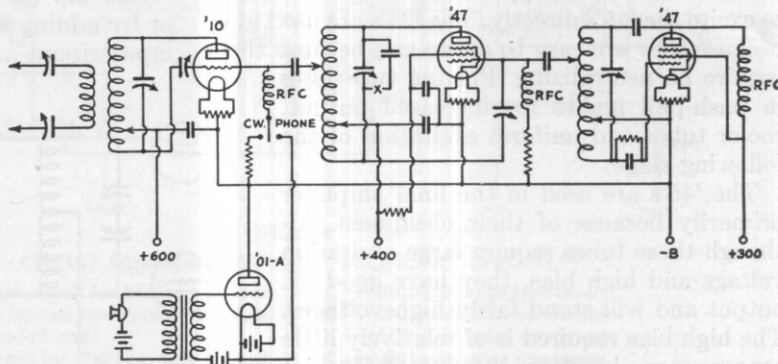


FIG. 25

W8DRJ'S M.O.P.A. TRANSMITTER

Self-excited pentode oscillator, pentode buffer and frequency multiplier, and a '10 final amplifier. This set works on three bands. The keying relay is inserted at X in the buffer tank circuit. Grid modulation with a Type '01-A tube is used for 'phone work. Values of the various components are the usual ones for the different bands.

mitter, and a separate power supply is used for each stage.

Despite the low power, this rig in various forms has worked 83 countries on c.w. and 16 on 'phone.

— Francis J. Cady, W8DRJ

Roy F. Bennett, W5AEJ, also a user of this system of modulation, describes his method of adjusting it as follows: The modulated amplifier is tuned up just as for c.w. work, and the excitation is then reduced until the maximum increase in antenna current is obtained when the microphone is spoken into. Note that this is not the same thing as adjusting for maximum antenna current. W5AEJ uses a Type '01-A to modulate a 211.

It should be pointed out that this modulation scheme is practically the same thing as the method described by Reuben A. Isberg in "Making Practical Use of Grid-Bias Modulation," page 37 August, 1932, *QST*, and is subject to the same limitations as the transformer-coupled system shown in that article. If the modulation percentage is to be high, the power output will be low, considering the power capabilities of the modulated amplifier for straight c.w. It is impossible to

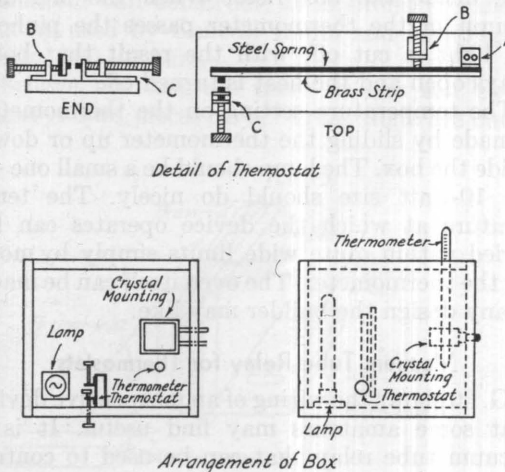


FIG. 26

obtain both high power output and high modulation percentages simultaneously without introducing a great deal of distortion and probably, also, over-modulation, with resulting spurious side-bands and broadness. These effects, unfortunately, cannot be detected by listening to the quality in an ordinary monitor, nor are distant listeners' reports of much value, since reports of "broadcast quality" are passed out for almost anything that is readily understandable. A vacuum-tube voltmeter such as the "modulometer" described in the *Radio Amateur's Handbook* should be used to check for over-modulation and to measure percentage of modulation.

Home-Made Temperature Control Box

FIG. 26 shows the details of construction of an inexpensive heater box for crystal control as used by Fred Mueller, W6EHO.

The box is $6\frac{3}{4} \times 8\frac{1}{4} \times 8\frac{1}{4}$ inches, and is constructed of Celotex. Screws are used for holding

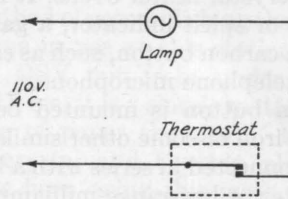


FIG. 27

the sides together, and all joints must be tightly closed to prevent heat leakage.

Perhaps the most interesting feature of the box is the homemade bi-metallic thermostat. A six-inch piece of steel spring taken from an old alarm clock and a piece of strip brass of the same size are held together by brass rivets spaced a quarter inch apart along the length of the two pieces, forming the expansion strip. As shown in the top view of the thermostat in Fig. 26, one end of the strip is held to a suitable base by the brass angle *A*; at the other end of the strip a contact point (points from ignition coils will do very well) is riveted on the brass side. A second contact point is riveted on a spring brass angle, *C*, which also is fitted up with a machine screw as shown in the end view to vary the gap between the points. A third angle, *B*, holds another machine screw which adjusts the position of the thermo-strip in relation to the contact *C*.

The lower part of Fig. 26 shows how the parts are arranged inside the box. The thermostat is mounted vertically on one side of the box with the screw *C* projecting through so adjustments may be made from outside. The lamp which furnishes the heat is one of the type used in music racks or show cases, and is mounted so that the thermostat is between it and the crystal mounting. A 0–100 degree Centigrade thermometer is mounted near the crystal as shown in the drawing. The wiring diagram is shown in Fig. 27.

In adjusting the thermostat the screw *B* is first set so the contact points are not quite touching (this adjustment may need to be changed slightly after the strip has been heated). Screw *C* is then set so the box operates at the desired temperature, a procedure which may take a little time since the air inside the box does not reach a steady temperature immediately.

A box of this type, while not capable of maintaining the crystal temperature within the small limits allowable for precision frequency work, is adequate for general amateur work where the

chief job of the oven is to compensate for variations in room temperature so that the crystal will not wander kilocycles from its nominal frequency.

A Novel Thermometer

FIG. 28 is the diagram of a new type of thermometer for crystal heater ovens. It has, instead of a mercury or spirit indicator, a galvanometer actuated by a carbon button, such as can be taken from an old telephone microphone.

The carbon button is mounted between two pieces of soft iron or some other similar metal, as shown, and connected in series with a battery and a galvanometer or low-range milliammeter.

The mounted button is then placed in the oven, and the thermometer is ready to use. When the heater oven is turned on, the heat expands the soft iron and the resulting pressure on the button lowers its resistance. This in turn makes the meter register more current. The thermometer can easily be calibrated, and this gives a fairly accurate measure of the oven temperature.

—Robert P. Gutterman, W1DHY-WIENM

Photronic Cell for Temperature Control

HERE is an interesting application for the Weston Photronic Cell in controlling the heat in a crystal oven. The cell with its associated equipment replaces the thermostat and it is claimed that with proper adjustment the control will be a great deal more accurate than that obtained with the usual bi-metallic thermostat.

Details of the arrangement are shown in Fig. 29. The thermometer itself becomes the controlling element, with a beam of light passing through it so that the light to the cell is cut off as the mercury column passes the mark at which the oven temperature is to be maintained. A light-proof box similar to that shown in the diagram has a hole cut in it through which the thermometer can be passed, the photronic cell being placed on one side and a lamp and lens on the other. On the lamp side of the thermometer there is a screen which completely cuts off the light to the cell side except for a pinhole in the center. The

position of the lens is adjusted so that a fine beam of light is focussed through the pinhole, behind which is the mercury column of the thermometer.

If the mercury column is below the pinhole the light passes through and falls on the cell. The current set up in the cell by the action of the light operates the miniature relay, R_1 , which in turn closes the circuit to relay R_2 , through a battery

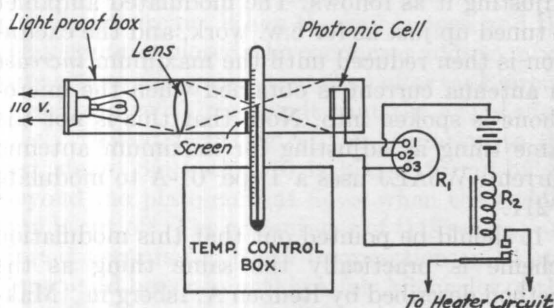


FIG. 29

USING THE PHOTRONIC CELL AS A LIGHT-OPERATED THERMOSTAT

of about 12 volts. Relay R_2 is the power-type relay furnished with the photronic cell kit. This in turn closes the circuit to the heater elements in the temperature-control box, and the temperature inside the box rises. When the mercury column of the thermometer passes the pinhole the light is cut off, with the result that both relays open and the heat is turned off.

The temperature setting on the thermometer is made by sliding the thermometer up or down inside the box. The lamp should be a small one — the 10-watt size should do nicely. The temperature at which the device operates can be varied within quite wide limits simply by moving the thermometer. The oven itself can be made to any design the builder may like.

Vacuum Tube Relay for Thermostats

FIG. 30 shows the wiring of an inexpensive device that some amateurs may find useful. It is a vacuum tube relay that can be used to control the heater circuits of quartz crystal ovens.

When the thermostat directly controls the heater current the break often is slow, tending to spoil the temperature regulation as well as creating objectionable interference in nearby receivers. This can be overcome by putting the control in a circuit where no sparking occurs, such as the plate circuit of a vacuum tube, and utilizing the thermostat only for controlling the grid bias of the tube.

In my set-up the tube is a Type '71-A, although any tube which will pass enough plate current to operate the relay will be satisfactory. The relay itself — usually an expensive item — is an ordinary 2500-ohm bell ringer taken from an old telephone box. The transformer puts about 200 volts on the plate of the tube and 70 volts on the grid. The chief

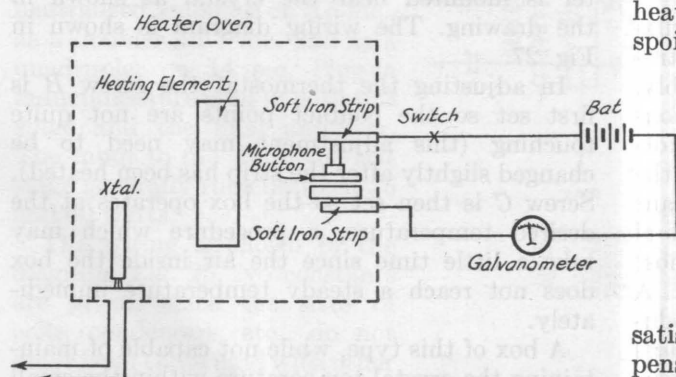


FIG. 28

MICROPHONE-BUTTON THERMOMETER FOR CRYSTAL OVENS

about these voltages is that the plate voltage should be high enough to close the relay when the thermostat is open, and the grid voltage should be such that when the thermostat is closed the relay will open.

When the thermostat controlled the heater, the thermostat directly the oven temperature varied

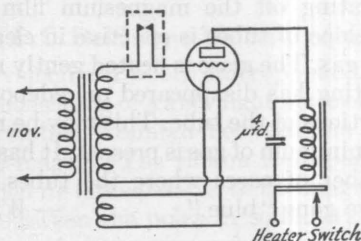


FIG. 30

at two degrees; with this arrangement the variation is not over .1 degree. Only a slight click heard in the receiver when the relay operates.

— Edward C. Carnes, W9DLG

Adjustable Crystal Holder

FIG. 31 is a diagram of a crystal holder which is the idea of about the simplest adjustable affair an amateur can construct. It is similar to the one being used by General Radio and Westinghouse for 100 kc. bars.

Believe my diagram more or less self explanatory. Two pieces of $\frac{1}{8}$ " brass angle are cut

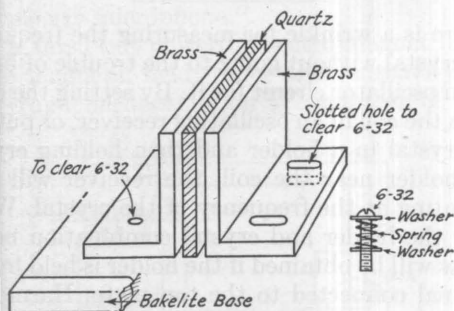


FIG. 31

to stock length with faces about equal to the thickness of the crystal. One is mounted permanently and the other is adjustable. The quartz plate is held on end. On the adjustable plate 6-32 fine screws with washers and springs under the heads are used for getting quick changes in adjustment for different crystals. I find with this holder air gaps as large as $\frac{1}{16}$ " will work with some crystals.

The plates should be as square as possible but the experiment shows that with most any crystal it is not necessary to have a precision-machined

This type of holder can be adjusted with a thickness gauge for about .001 to .005" clearance between the crystal. The crystal can be held in the

hand and lowered into the holder, and if it is a good oscillator it will start before you let go of it.

— James Wood, W1AYG

Easy QSY with Crystal Control

QSY with crystal control has often been mentioned, but I don't remember ever having seen as simple a method of accomplishing the frequency shift as the one in use at this station. When it is desired to QSY out from under a station interfering with me, it is a simple matter to insert a little square of paper the size of the crystal between the crystal and the top plate of the holder. I have been using this method of QSY with a '47 pentode oscillator with about 400 volts on the plate, and the output does not seem to be affected when only one sheet of paper is between the top plate and the crystal. The frequency shift is enough with only one piece of paper to move my signals out from under those of the interfering station. With two pieces of paper in place, the output goes down a little, but the frequency shift is proportional to that caused by the first paper spacer. The output of the oscillator is still more than sufficient to excite a pentode doubler. This QSY stunt has been in operation on the 7000-kc. band for some time (using a 3500-kc. crystal) and has performed admirably.

— Frank D. Lewis, W9AOG

Switching the Plate Meter

IT IS common practice when a single milliammeter is used to read currents in several stages in a transmitter to use a system of plugs and jacks. However, when only two circuits are to be metered, as in a straight m.o.p.a. transmitter, the job can be done much more conveniently using a double-pole double-throw switch, as shown in Fig. 32. The meter is placed in the negative lead, and the switch automatically closes the center-tap to one tube when the meter is switched to the other. W3HJ uses a Yaxley jack-switch, which looks neat on a panel and takes up little space.

The same idea can be used to make one meter read both grid and plate current on a single stage when a separate milliammeter is available for each stage.

— Richard R. Turner, W3HJ

W8BIB uses old ferrotype or squeegee plates (used to dry photographic prints) to enclose the sides and back of his transmitter frame. The plates are made of soft sheet

iron, have a glossy black finish, and can be easily cut to size with tin shears. They can often be

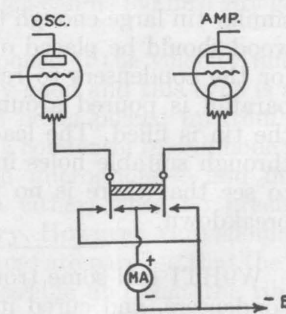


FIG. 32

picked up at photographic establishments for the asking.

A simple arrangement for keeping the filaments from blinking when the transmitter is keyed is to wind a few extra turns on the core of the power transformer, if space will permit, and connect them in series with the primary of the filament transformer. Three or four turns usually is enough. The key should be in the primary circuit of the power transformer. — W7ASQ

R.f. chokes can be had by yanking apart those old R.C.A. r.f. transformers and using the coils out of them. The connections in the center should be soldered together, as these wires are not otherwise connected after dismantling. They make fine chokes for 40 and 80, and will easily stand anything a 210 can do to them. — W1UT

The foil from an old filter condenser makes excellent fuse material for protecting high-voltage rectifiers. To make a fuse for a Rectobulb the foil should be cut in a strip about an eighth of an inch wide and about an inch long. Narrower strips will do for smaller rectifiers. These fuses can be mounted in any convenient way. — W6DER

W3AHQ has an auxiliary key connected in the 110-volt line to his transmitter and placed on the floor under the operating table within easy reach of his foot. Besides making a convenient power switch for ordinary operating, the key is handy when making adjustments to the transmitter because the power can be put on and off quickly. If things start to happen in the set the juice can be turned off in jig time.

W8BMF finds that antenna insulators make good winding forms for r.f. chokes. A choke suitable for the 3500- and 7000-kc. bands can be made by winding 45 turns of No. 24 in each groove of an insulator having four grooves.

Unmounted filter condensers may be fixed up neatly by putting them in cocoa tins or some similar tin large enough to hold them. A piece of wood should be placed on the bottom of the tin for the condensers to rest on, and then melted paraffin is poured around the condensers until the tin is filled. The leads may be brought out through suitable holes in the cover, taking care to see that there is no possibility of insulation breakdown. — W1AQW

W9HTI had some trouble with sparking tank condensers, and cured it by giving the plates a thin coat of clear lacquer. This increased the breakdown voltage without materially affecting the capacity.

Wall insulators of the G. R. type make good and easily-mounted forms for r.f. chokes for the transmitter. The grooves should be wound full of No. 28 or 30 d.c.c. wire in the same way as the usual slotted forms of composition or wood.

— W6ASY

Evaporating off the magnesium film on the glass envelope of tubes is effective in clearing up any stray gas. The glass is heated gently until the silver coating has disappeared or redeposited on cooler portions of the tube. This may be repeated until the minimum of gas is present. It has worked in a number of cases where the tubes, mainly 210's, have gone "blue." — W2CGL

W5LB uses an "A" eliminator to give him a time delay in turning on the plate power after the transmitter filaments are lighted. The output of the eliminator builds up rather slowly when turned on, and is used to energize an old telegraph sounder rebuilt into a relay. The tension on the relay can be adjusted so that the plate circuit is closed from ten to thirty seconds after the filaments reach their operating temperature.

Raytheon or similar gaseous rectifier tubes can be used to indicate r.f. in the same way as neon bulbs. They are less sensitive than the small neon tubes, however.

— Raymond Popkin, Brockton, Mass.

Here is a wrinkle for measuring the frequency of a crystal without going to the trouble of building an oscillator circuit for it. By setting the crystal on the coil of an oscillating receiver, or putting the crystal in a holder and then holding crystal and holder near the coil, the receiver will stop oscillating at the frequency of the crystal. When using the holder and crystal combination better results will be obtained if the holder is held by the terminal connected to the top plate. Harmonics of the crystal also can be picked off, which no doubt would help in calibrating a frequency meter. — K6CFQ-BUC

W9AQT suggests the following method of making an r.f. choke with comparatively little external field to get mixed up with the fields about the transmitting coils. Procure a piece of half-inch rubber tubing from the dime store and wind enough No. 36 d.s.c. wire on it to make a coil about two inches long. Cut off the ends of the tubing about an eighth of an inch from the ends of the winding and bend the whole works into a circle, after the fashion of the old toroid inductances. This choke was found to be adequate at 3500 kc. Practically all of the field is concentrated inside the coil.

FOR THE 'PHONE AMATEUR

A D.C. Field Type Velocity Microphone

THE velocity (ribbon) microphone is simplicity itself, consisting of a very light piece of corrugated metal ribbon mounted between the poles of an electro-magnet. The ribbon is suspended loosely and with its faces parallel to the magnetic lines of force between the poles. A sound wave, which is made up of alternate rarefactions and condensations of the air, striking the surface of the ribbon causes it to move backward and forward. This movement of the ribbon causes it to cut the magnetic lines of force between the poles of the electro-magnet and a minute alternating voltage is induced in the ribbon. This signal voltage is fed through an input transformer to the grid of the first tube in the microphone amplifier. Since the movement of the ribbon corresponds to the rarefactions and condensations in the air, the alternating voltage produced is of the same frequency as the sound. Unlike most microphones, the velocity type delivers a voltage which is essentially independent of frequency and dependent only on the amplitude of the sound — and, hence, on the velocity of the ribbon. Therefore the name, "velocity microphone."

A small but powerful electro-magnet furnishes the magnetic field. Since the sensitivity of the microphone depends on the number of lines of

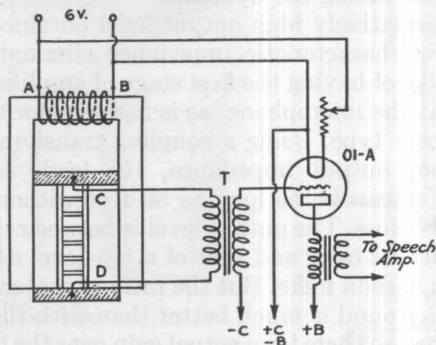


FIG. 1

CIRCUIT CONNECTIONS FOR THE D.C. FIELD TYPE MICROPHONE

force cut by the ribbon, the electro-magnet should be designed so that it will produce as great a magnetic flux as possible. Therefore the iron used should have high permeability.

Get the best grade of electrical iron obtainable in your locality. Annealed cast steel having high permeability was used for the magnet of the microphone built here, and it is very sensitive. The coil consists of 400 turns of No. 24 d.c.c.

magnet wire wound in layers, with the finished winding given a coat of shellac or Duco. The magnet is assembled as shown in Fig. 2, assuming that the parts have been cut, drilled and tapped as specified. The drawing should be self-explanatory.

Next the ribbon should be made. The material should preferably be duralumin, although brass can be substituted. From stock one-half mil thick cut a piece $\frac{3}{16}$ -inch wide and 3 inches long. Corrugate it by running it through a set of coarse gears. This corrugation is to prevent standing waves on the surface of the ribbon and to keep the natural frequency of the ribbon out of the frequency range normally used. The ribbon is now supported without tension by the insulating strips shown in the drawing, being slipped into the saw cut in the strips and clamped with the bolts which also act as terminals. The ribbon and the two insulating strips are now assembled between the poles of the electro-magnet and the air-gap on each side made as small as possible, without allowing the ribbon to touch the pole pieces, by sliding the poles together. When the adjustment is complete, clamp the pole pieces to the yoke by the clamping bolts, tighten the four bolts holding the insulating pieces securely — and the microphone is completed.

Because the ribbon is short the impedance is low. To match this low impedance to the high impedance of the grid of the amplifier tube it is necessary to use a step-up input transformer. A suitable transformer can be made easily by removing the primary winding from an audio transformer and substituting a low-impedance winding (10 turns or so) to match the impedance of the ribbon. Such a transformer will enable you to obtain maximum transfer of energy from the ribbon to the amplifier. Fig. 1 shows the connection of the microphone to the microphone amplifier, the output of which can be fed into any good two-stage amplifier.

The frequency response of the velocity microphone is exceptionally good and this type is also directional, no sound being picked up from the sides. It is as good as a condenser microphone and better than a carbon microphone — and much easier to build than either, since no precision machining is necessary. However, care should be taken that the pole faces are parallel, that the air-gap is as small as possible and that the ribbon does not strike the pole faces as it vibrates. After assembly in the aluminum case it presents an appearance of which any builder can well be proud.

— C. W. Melotte

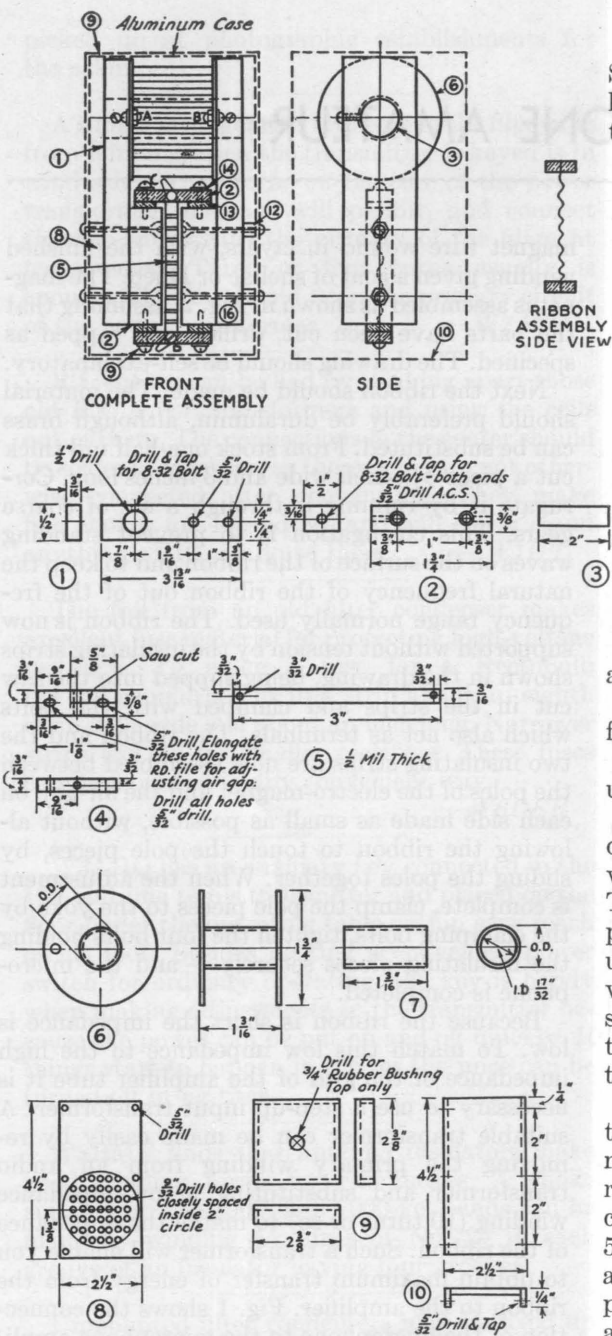


FIG. 2

DETAIL OF THE D.C. FIELD VELOCITY MICROPHONE CONSTRUCTION

- 1 — 2 pole pieces of magnetic iron steel. These pole pieces are one inch wide and $\frac{3}{8}$ -inch thick — the dimensions given on the drawing being incorrect.
- 2 — 2 pole faces of magnetic iron of steel.
- 3 — 1 yoke, magnetic iron or steel.
- 4 — 2 pieces bakelite for ribbon support.
- 5 — 1 Dural ribbon.
- 6 — 2 cardboard or fiber ends for winding form.
- 7 — 1 cardboard or fiber core for winding form.
- 8 — 2 pieces of aluminum for back and front of case.
- 9 — 2 pieces of aluminum for top and bottom of case.
- 10 — 2 pieces of aluminum for ends of case.
- 11 — $\frac{1}{4}$ lb. No. 24 d.c.c. magnet wire.
- 12 — 4 brass bosses.
- 13 — 4 fiber washers.

The Permanent Magnet Type

SEVERAL ribbon type microphones constructed here have proven themselves superior to other types in a number of respects. The first one made had a six-volt field coil but, since this necessitated a 6-volt storage battery for operation, the permanent magnet type shown in Fig. 3 was developed. This is somewhat more bulky than the other, but still is not so large as the usual condenser head with its amplifier. The advantages of the permanent magnet type velocity microphone are as follows:

1. No background hiss like that common to carbon mikes of any type.
2. Ruggedness. This one has fallen off the operating table without damage.
3. Considerably higher output level and much lower impedance than the condenser type, its nearest rival in quality of performance.
4. No batteries required to supply field — or anything else.
5. It is directional. Room noise or echo coming from the sides does no damage.
6. Having no diaphragm, it is free from the usual frequency peaks in response.

The no-background feature is important because it permits running the level up further, obviating the necessity of talking close to the mike. This is helpful when an inexperienced talker is performing for monitoring purposes and in pick-up work. The feature of ruggedness is especially valuable in amateur work. A ham mike must stand the gaff — and then some. This type lacks the common fragility of stretched diaphragm types, including the dynamic.

The relatively high output level obtained and the low characteristic impedance eliminate the necessity of having the first stage of amplification right at the microphone, as is necessary with the condenser type. Using a coupling transformer of 500-ohm output impedance, the leads to the amplifier can be as long as 30 feet without appreciable loss. The output level is between that of a condenser head and that of a low-level double-button carbon mike. But the ratio of speech level to background is much better than with the carbon type, so there is an actual gain over the latter. The no-battery feature is a real drawing card for the ham who shies at the high polarizing voltage required for the condenser and the usual battery demanded by the carbon type. There are never enough batteries in any ham's shack.

The frequency characteristic of the velocity

- 14 — 4 brass washers.
- 15 — 8 round-head brass bolts, 8-32 $\frac{1}{2}$ -inch long.
- 16 — 4 flat-head brass bolts, 8-32 1-inch long.
- 17 — 2 round-head brass bolts, 8-32 $\frac{3}{8}$ -inch long.
- 18 — 2 round-head steel bolts, 8-32 $\frac{3}{8}$ -inch long.

Also required: 14 brass nuts for 8-32 screws; 16 lock washers for 8-32 screws; 4 tinned copper terminals; $\frac{1}{2}$ pint black Duco.

microphone is comparable to that of the condenser type, dropping uniformly towards the higher frequencies but being free from the usual humps. This one is flat to about 3000 cycles. Its output at higher frequencies could be equalized by compensation in an audio stage if such response should seem desirable. However, everything over 3000 cycles is so much wasted in voice communication and most of the useless noise components are in the higher frequencies.

The low impedance of the ribbon calls for a few turns of large wire on the primary of the coupling transformer, 10 turns of No. 18 being about right. If the microphone is to couple into the grid of the first amplifier through a short line, the transformer can be right at the grid of the tube. In this case, the 10-turn primary can be put on in place of the usual primary of the first audio transformer. If the microphone is to be removed some distance from the amplifier, a mike-to-line transformer should be used at the input and a line-to-amplifier transformer at the output end. The input transformer can have the same 10-turn primary as the transformer just described and a secondary of about 500 turns of No. 30. The output transformer can be the usual amplifier input transformer with a 500-turn winding of No. 30 replacing its high-impedance primary. It should be unnecessary to mention that usual good practice in shielding microphone leads and grounding the shield ought to be observed.

— George A. Elliot, W9ADZ

In connection with velocity microphones, W4IS writes that the aluminum foil in which Eastman Autographic Films are wrapped is $\frac{1}{2}$

mil thick and works to perfection in this type of mike.

How to Make a Condenser Microphone

WHY, when you talk condenser microphone to most amateurs, do they throw up their hands and say "N.D."? Well, probably because many condenser mikes are so insensitive that they require too much audio gain, are too complicated to make and too tricky to adjust. The one here at W1BVS has good sensitivity, is easily built and has a dual adjustment feature that eliminates the trickiness. It has given perfectly satisfactory results and most always causes comment on the part of the fellows worked because of the very good quality and lack of background noise.

The two most important features in a condenser mike are the adjustment of the tension on the diaphragm and the adjustment of the gap between the diaphragm and back plate. The two adjustments should be entirely independent of each other. Otherwise when the gap is right the diaphragm tension is likely to be wrong, and *vice versa*. If the adjustment to give the proper diaphragm tension for good frequency response makes the gap too great, then the sensitivity is poor. If the adjustment to give the proper gap for good sensitivity makes the diaphragm tension other than what it should be for good frequency response, then the "quality" is punk. Unlike the usual condenser mike intended for amateur construction, this one provides for independence of these two all-important adjustments and does it simply.

The materials used for this job require a minimum of machine work and are of a type that is generally available, the whole thing being built around an obsolete magnetic loud-speaker unit of a type widely distributed in years past and still to be found kicking around radio shop "graveyards" in goodly numbers. As an alternative to this unit, the whole head can be machined to the specifications given in the drawings.

First procure from the junk pile, or some of your friends, an old Atwater-Kent goose-neck speaker of the vintage of about 1925; the model number of this one is 636722. Any amateur will recognize this speaker. It has an adjustable unit in the base. Throw away the horn and unscrew the unit from the base and throw the base away too. Now dissect the unit and take out the pole pieces, magnets, diaphragm and tension ring. Save the tension ring and diaphragm and heave out the pole pieces and magnets.

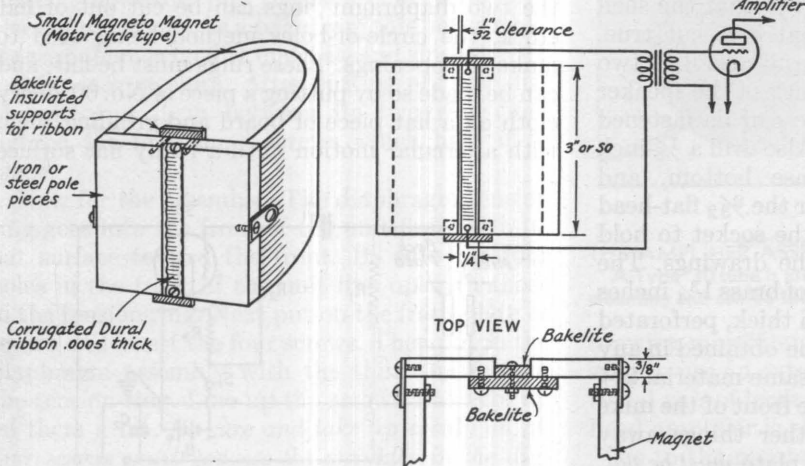


FIG. 3

SUGGESTED CONSTRUCTION FOR THE PERMANENT-MAGNET TYPE VELOCITY MICROPHONE

There is nothing very critical about it. The magnet is of the type used in ignition magnetos, the motorcycle type being suitable. These can be picked up in junk yards and re-magnetized at a repair shop if necessary. The pole pieces should be suited to the magnet procurable. If dural cannot be had for the ribbon, a "stiff" type of tin or aluminum foil can be used. The corrugation is necessary to prevent resonance. The ribbon should be suspended loosely and not stretched.

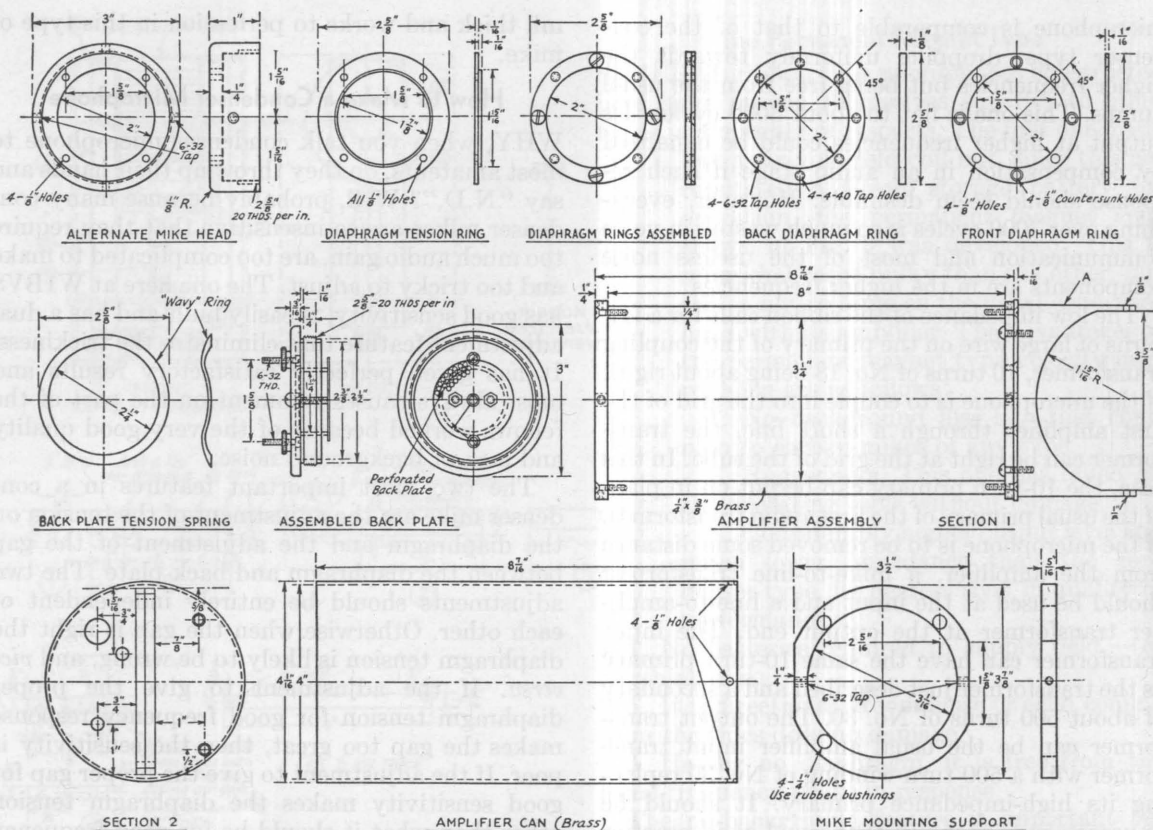


FIG. 4

DETAIL OF THE CONDENSER-HEAD COMPONENTS

In the drawing of the diaphragm tension ring the lip should be 3/22" instead of 1/16".

The first construction is the back-plate mounting. Salvage a 4-prong bakelite tube base, break out the pins and cut off the top so that the shell is $1\frac{1}{16}$ -inch long, being sure that it is cut true. Drill out two of the pin holes and also drill two $\frac{1}{8}$ -inch holes to match in the back of the speaker unit so that the sawed-off base can be fastened on the little ears in the center. Also drill a $\frac{1}{8}$ -inch hole centered in the tube-base bottom, and countersink from the outside for the $\frac{9}{32}$ flat-head screw which goes up through the socket to hold the back plate, as shown in the drawings. The back plate is made from a piece of brass $1\frac{3}{4}$ inches in diameter and about .020 inch thick, perforated with $\frac{1}{16}$ -inch holes. This can be obtained in any hardware store. A piece of the same material $2\frac{5}{8}$ inches in diameter is used on the front of the mike to keep poking fingers and other things away from the diaphragm. The back plate *must be flat*, and is soldered to the screw coming up through the center of the tube base. This plate forms one connection of the mike, the shell being the other. This completes the rear section.

Now for the diaphragm and front end. First take the front shell and make a hole $1\frac{1}{2}$ inches in diameter in the center of it. This can be turned out in a lathe or made by drilling a row of holes and using a hammer and chisel, with a file for

finishing. Also drill the four $\frac{1}{8}$ -inch holes for mounting as shown in the drawing and photographs.

Now make up the three rings as per the drawings. These are of brass and can be turned out very easily in a lathe. In case one is not handy, the two diaphragm rings can be cut out of flat stock, the circle-of-holes method being used to make the openings. These rings must be flat, and can be made so by putting a piece of No. 00 emery cloth on a flat piece of board and grinding them with a circular motion until a really flat surface

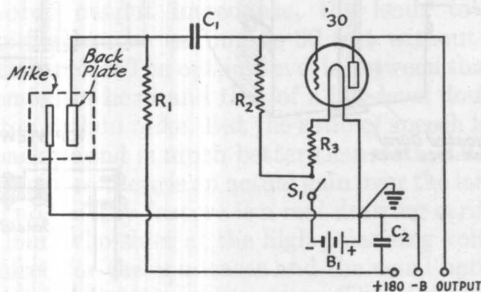


FIG. 5

CIRCUIT OF THE HEAD AMPLIFIER

- R₁ — 3-meg. coupling resistor.
- R₂ — 5-meg. grid resistor.
- R₃ — 17-ohm filament resistor (20-ohm unit with 3 ohms shorted).
- C₁ — 0.006 μ fd.
- C₂ — 1.0 μ fd.
- S₁ — Single-pole single-throw "A"-battery switch.
- B₁ — Two flash-light cells (large type) in series.
- "Ground" indicates connection to shield.

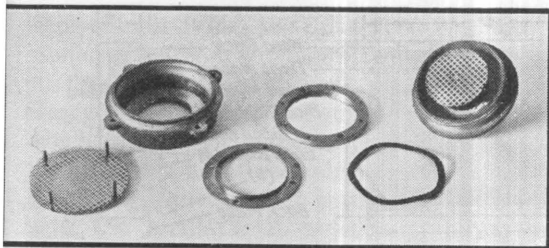


FIG. 6

THE ESSENTIALS OF THE CONDENSER UNIT

They go together in the order shown, from left to right, and are identified as the front cover screen, head casing, diaphragm tension ring, diaphragm and diaphragm ring assembly, back-plate tension spring and, finally, the back-plate assembly. Further details are shown in the drawing.

is obtained. On the tension ring (the one with the projecting lip) a little ingenuity on the part of the amateur will be called for. If a lathe is available, the whole thing can be turned out of one piece of brass. If hand tools are the only recourse, the logical procedure is to make the two pieces separately and sweat them together with solder. One thing to remember is that the projection of the tension ring that goes against the diaphragm must be smooth and have no burrs or rough spots. Otherwise when the ring is drawn up it may punch a hole in the diaphragm.

The diaphragm is made either of duraluminum .001-inch or less thick, or of the foil from a cigarette package. That from "Old Gold" is about the right thickness and tensile strength. If you use the foil take it off very carefully from a new package, so as not to make any creases or pin holes in it, and cut it out the same size as the old diaphragm, using the latter as a templet. Before cutting, however, put the tinfoil on a smooth piece of paper such as a page from this book, making sure there is no dirt under it, and smooth with a soft piece of cloth. After cutting out the diaphragm, put it in between its two rings and tighten the four small screws which hold it in place.

Now for the assembly. The diaphragm tension ring goes into the front of the unit first, with its flat surface toward the front. Be sure the four holes in the front of the unit line up with those in the tension ring. Next put on the front plate or screen and insert the four screws. Then put in the diaphragm assembly with the thin ring toward the tension ring. Line up the screws and take up on them a bit. *Be sure and take up evenly on all four screws until you see the wrinkles in the diaphragm just disappear.* Do not take up much after this occurs because that is about the proper tension. Now slip in the spring (the wavy ring) that keeps tension on the back part of the unit, and screw in the back section.

Before going further, connect a dry cell and a pair of 'phones, or high-resistance voltmeter, in series across the mike terminals. If you screw in the back part of the mike carefully you will hear

a click and a grating noise, when the diaphragm and back plate just touch. *Do this very carefully — you might ruin the diaphragm.* When you hear the click (which means that the back plate is against the diaphragm), back off just a hair and blow on the diaphragm, not too hard, and adjust until there is no noise.

This completes the head unit. The mounting and amplifier can be made to suit the individual, but one thing must be remembered. *Keep the lead from the back plate to the grid condenser and grid as short as possible.* As shown by the photos, the tube is hung upside down in the head amplifier to make these connections meet this requirement. The head-amplifier shield can be cylindrical like the one shown, which is 4 inches in diameter and 8½ inches high, or can be square. A dry-cell "A" battery for a Type '30 tube may be placed right on the shield, as is done in this case. With a tube

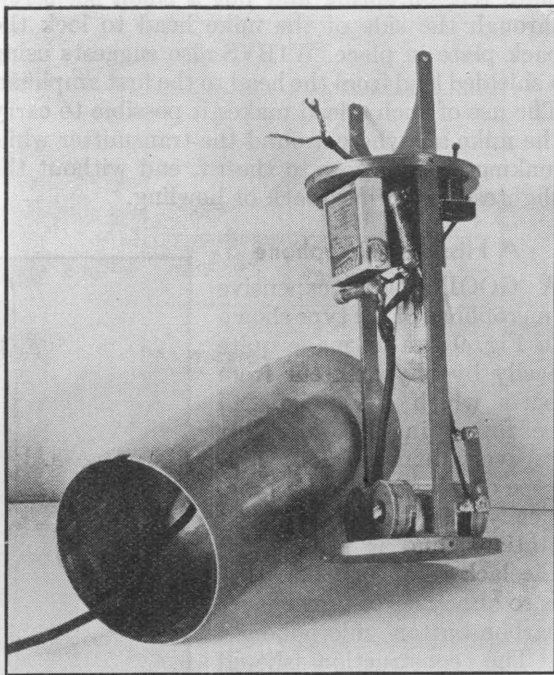


FIG. 7

THE AMPLIFIER ASSEMBLY SLIDES OUT OF ITS SHIELD

A Type '30 tube is used. The condenser head fits in the forked mounting and can be tilted to a convenient angle.

drawing more filament current it would be necessary to use an external "A" supply and an additional pair of leads in the cable. The circuit of the head amplifier is shown in Fig. 5.

As to the number of stages necessary for good output, here at W1BVS I use either of two amplifiers. One is a Western Electric 7-A which has one '12-A in the first stage and two '71-A's push-pull in the second stage. The other amplifier is single stage using a '33 pentode. Either of these works into a pair of '45's push-pull; and these excite two Type '10's as Class B modulators. And the '10's will put out 50 watts of audio nicely, as I can prove.

So there is nothing terribly complicated about a condenser mike, and any amateur who knows how to use a few tools can build one. The drawings show an alternative design in case one has the facilities of lathe to turn one up. When using the mike, do not put it inside a copper or tin box that may be subject to mechanical vibration and which will set up an unpleasant ringing sound.

If a little care and patience are observed, I am sure that any amateur can build a mike as good as this one and I know it will improve the quality of the output from his station. It is well worth the time and small amount of money spent.

— Howard F. Anderson, W1BVS

Since the article was written it has been found advisable to do away with the back-plate tension spring and put a small set screw through the side of the mike head to lock the back plate in place. W1BVS also suggests using a shielded lead from the head to the first amplifier. The use of such a lead makes it possible to carry the mike anywhere around the transmitter while making adjustments to the r.f. end without the slightest sign of feedback or howling.

A Hissless Microphone

A GOOD and inexpensive microphone of the type shown in Fig. 9 can be made quite easily by any amateur from parts which can nearly all be found in the junk box in every ham station. This type of mike is used by practically all Australian 'phone stations, and is notable for the lack of carbon hiss that is so annoying in the cheaper carbon-button microphones.

The construction should be evident from Fig. 5. A wooden block of the dimensions shown forms the "bed-plate" of the instrument. Mounted on it is a piece of $\frac{1}{8}$ -inch bakelite measuring $4\frac{1}{2}$ by $3\frac{1}{2}$ inches, drilled at the corners to pass the wood screws which hold it in place. On top of this is a second bakelite piece made as shown at B. The cut-out portion of B is the chamber in which the carbon is placed, and also contains the two electrodes, which are pieces of brass or copper of the size shown at A. The electrodes are drilled and countersunk to take

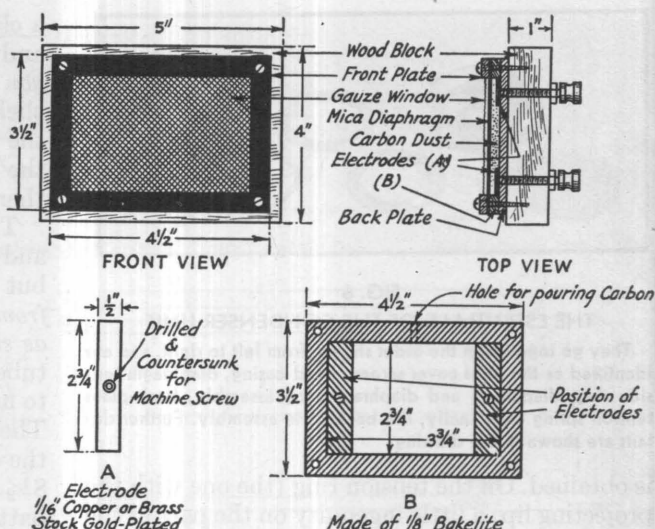


FIG. 9

A MICROPHONE WHICH HAS A LOW HISS LEVEL

machine screws, and are mounted on the back plate at the edges of the opening in B. The diaphragm, which is a piece of mica the same size as the back plate, goes on top of B. The diaphragm should be of the order of .002 of an inch thick. Finally there is a front plate, cut out in the same way as B, in which a piece of metal gauze is inserted to protect the diaphragm.

The secret of reducing the hiss is in gold-plating the electrodes, a job which any jeweller can handle. The carbon should be high grade, and should be about as fine as face powder. The microphone is used with a $22\frac{1}{2}$ -volt B battery, and at this voltage the drain is about 6 milliamperes.

— M. M. O'Brien, VK4MM

An Inexpensive Way to Operate a Condenser Mike

THE condenser microphone is usually considered to be a piece of equipment that has high initial cost as well as high operating expense. The depression was responsible for a new mike arrangement at W8FSC. It worked so well that it must be passed on to the rest of the gang. It isn't original, but what is?

An ordinary condenser microphone head is used as the tank capacity in a small oscil-

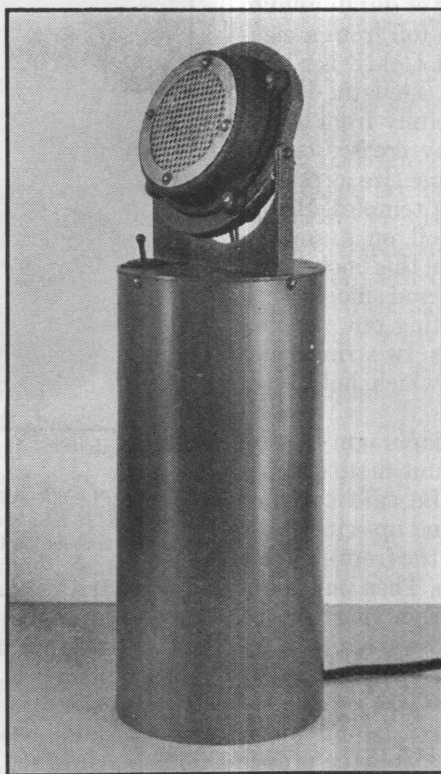


FIG. 8

THIS PROFESSIONAL APPEARING AND WORKING CONDENSER MICROPHONE HAS SEPARATE ADJUSTMENTS FOR DIAPHRAGM TENSION AND CONDENSER GAP, GIVING HIGH SENSITIVITY AND EXCELLENT FREQUENCY RESPONSE. THE HEAD AMPLIFIER IS CONTAINED IN THE BASE

lator circuit. When the mike is spoken into, the oscillator is frequency-modulated. (Don't get excited yet.) To obtain an audio signal it is only necessary to demodulate the output of the oscillator, which can be done by the oscillator tube itself with the aid of an additional absorption tank circuit. When this added circuit is tuned near resonance with the oscillator it absorbs power from it, causing a change in oscillator plate current. When the oscillator is modulated its frequency varies, resulting in a change in the amount of power absorbed by the coupled circuit. The oscillator plate current varies at audio frequency as it supplies this changing load. The primary of an ordinary audio transformer can therefore be placed in the oscillator plate feed line to pick up this audio current and feed it to the speech amplifier grid. Fig. 10 shows how it's done. The curve of Fig. 11 is typical of the operating conditions.

Now for the advantages of this scheme. First, the output of the oscillator and mike is a little greater than that of a W.E. 387. The use of a large bank of "B" batteries is unnecessary; in fact no batteries are needed at all. As used at W8FSC, a '27 is used as the oscillator, with a.c. on the filament and r.a.c. on the plate. The hum is surprisingly low. (A '24 was later substituted with a big increase in output.) A single 45-volt block of "B" battery does, however, make the oscillator free from creeping because of voltage changes. The fidelity of the outfit is nearly as good as the standard condenser mike and its associated two-step amplifier.

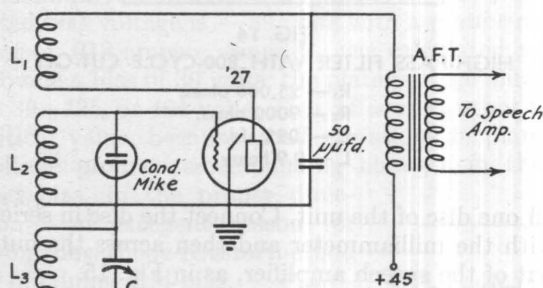


FIG. 10

CONDENSER MICROPHONE OSCILLATOR CIRCUIT

L_1 , L_2 and L_3 are all wound on the same piece of 1-inch tubing. The first two each have eight turns of No. 22, with a space of $\frac{1}{8}$ inch between the two coils. L_3 has 20 turns of No. 30 wire, and is placed on the form $1\frac{3}{4}$ inches from L_2 . Condenser C is a 50- μ fd. midget.

When the scheme was explained to a 'phone we worked, he promptly came back with a report that our carrier was being frequently modulated. This was of course untrue, because the transmitter was crystal-controlled and the microphone oscillator had nothing to do with the r.f. portion of the transmitter. This operator must have had a severe case of "frequency-modulation-fright." Would that more had!

The scheme makes condenser mike quality possible at low cost. Let's hear more of them.

— Robert L. Drake, W8CYE-W8FSC

The '47 as a Speech Amplifier

FIG. 12 is the diagram of a speech amplifier used by Basil Cutting, W1APK, for which he claims the advantages of high gain with a minimum number of tubes, and — because two amplifier stages replace the usual three for the same gain — lower cost, less chance for r.f. and audio feedback, and simplicity of construction.

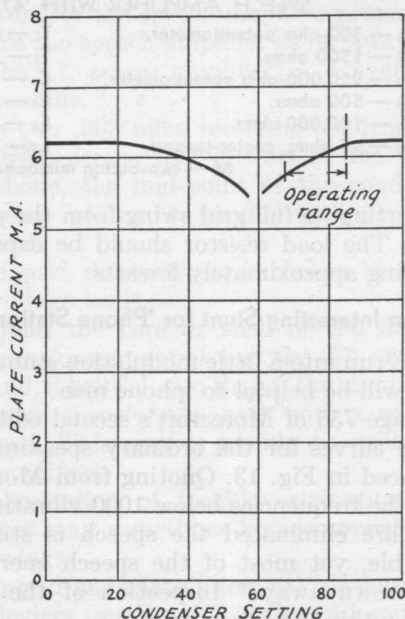


FIG. 11

SHOWING THE EFFECT OF THE SETTING OF C ON THE OSCILLATOR PLATE CURRENT

Choose an operating point on either side of the exact resonance point, but on a sloping portion of the curve.

The first amplifier tube is a '27, which is transformer coupled to the second tube, a Type '47 pentode. The output of the second stage is impedance-coupled to the grid of the modulator, an 845. The constants are given under the diagram. There should be little difficulty in getting an amplifier of this type to work.

In using the pentode in this fashion, it would be advisable to connect a resistor of suitable value in parallel with L_1 to keep second-harmonic distortion at a minimum. The recommended value for this load resistor is 7000 ohms with 250 volts on the plate and 16.5 volts grid bias. Under these conditions the voltage gain in the '47 itself is about 11, the output being in the neighborhood of 180 volts, peak. The load resistance may be increased to 10,000 ohms or so without causing an objectionable increase in second-harmonic distortion if a somewhat higher voltage gain is desired. With a 7000-ohm load the output voltage will be sufficiently high to excite an 845 modulator to full output, however, provided the loss in the coupling impedances is small, and assuming the

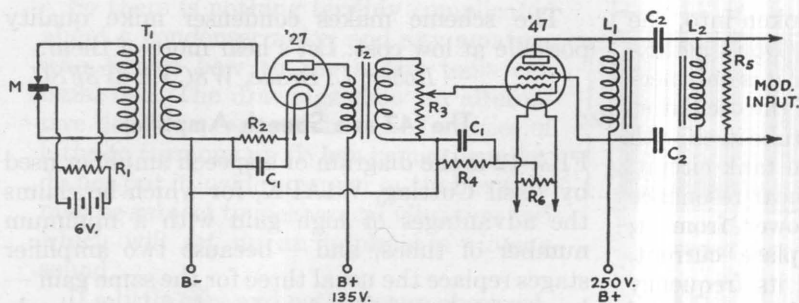


FIG. 12

SPEECH AMPLIFIER WITH '47 PENTODE

- | | |
|---|--|
| R ₁ — 300-ohm potentiometer. | T ₁ — Microphone transformer. |
| R ₂ — 1500 ohms. | T ₂ — Audio transformer. |
| R ₃ — 250,000-ohm potentiometer. | C ₁ — 1- μ fd., 200-volt rating. |
| R ₄ — 500 ohms. | C ₂ — .5- μ fd., 600-volt rating. |
| R ₅ — 100,000 ohms. | L ₁ — 30 henrys. |
| R ₆ — 15 ohms, center-tapped. | L ₂ — 200 henrys. |
| M — two-button microphone. | |

'47 is getting its full grid swing from the preceding '27. The load resistor should be capable of dissipating approximately 5 watts.

An Interesting Stunt for 'Phone Stations

I HAVE run into a little modulation stunt that I believe will be helpful to 'phone men.

On page 755 of Morecroft's second edition we find the curves for the ordinary speaking voice reproduced in Fig. 13. Quoting from Morecroft, "If all the frequencies below 1000 vibrations per second are eliminated the speech is still 85% intelligible, yet most of the speech energy has been thrown away." Inspection of the curves will show this to be very true.

Suppose a high-pass filter which cuts off at 1000 cycles is used in the speech amplifier of a 'phone transmitter. Inspection of the curves will show that at least four-fifths of the energy has been eliminated. Only 20% modulation would then be required to give the same range as 100% modulation without the filter. Or 100% modulation with the filter should give the same range as a transmitter with five times as much carrier power.

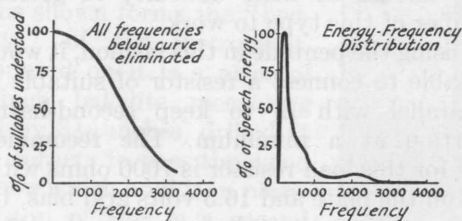


FIG. 13

To test this idea a high-pass filter having a cut-off frequency of 800 cycles was constructed, with terminating impedances of 9000 ohms, as shown in Fig. 14. This filter was then connected to a 'phone receiver. Voices sounded clear and a great deal of the 60-cycle grumbles and low-frequency hash in the 'phone band disappeared.

The voices in many cases sounded more *human*.

The filter was then tried in the speech amplifier of W3CIJ and results were immediately noticed. The range seems much increased and the transmitter seems especially good at working through QRM, as was to be expected with the weak carrier relative to the apparent speech level. Most stations worked report better modulation with the filter. This ability to get through beat notes and QRM should make this a valuable stunt in the crowded 'phone bands.

Before putting the filter in the transmitter it should be tried on the receiver to make sure that good intelligible speech can get through it.

— John P. Shanklin, W3CIJ

A Cheap Level Indicator

GET a 0-1 or 0-1½ d.c. milliammeter and a Kuprox or some such dry-plate rectifier and take

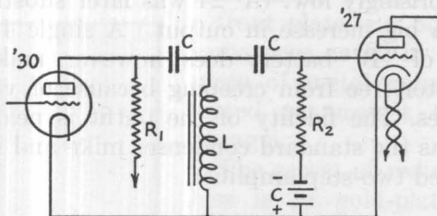


FIG. 14

HIGH-PASS FILTER WITH 800-CYCLE CUT-OFF

- | |
|-------------------------------|
| R ₁ — 25,000 ohms. |
| R ₂ — 9000 ohms. |
| C — .022 μ fd. |
| L — 0.9 henry. |

off one disc of the unit. Connect the disc in series with the milliammeter and then across the output of the speech amplifier, as in Fig. 15.

Possibly a carborundum detector or even a galena crystal would work as well. I have not tried any but the Kuprox unit but no doubt the others would be satisfactory.

— Jas. R. Donovan, W4WZ-WTOC

The 57 as a High Gain Audio Amplifier

AMATEURS operating or planning to operate 'phone transmitters should be especially interested in the 57. This is one of the new 56-57-58 series having a 2.5-volt one-ampere a.c. heater and a six-pin base.

The two-stage speech amplifier to be described was hastily put together bread-board fashion one afternoon for no better reason than that the writer was in an experimental mood. This amplifier, totally unshielded and placed only six feet from

the tank coil of a Type '04-A, furnished enough voltage to over-swing a Type '51 (400-watt) modulator — and the quality was as good if not better than that obtainable with the '27-'27-'10 combination previously used. The actual gain of the 57 with the circuit constants shown is approximately 200, giving a peak voltage swing of slightly over 200 volts for the next stage, assuming a one-volt signal input. No trouble at all was experienced with r.f. or audio howling or "singing," although the three-wire cable from the double-button microphone was only partially shielded.

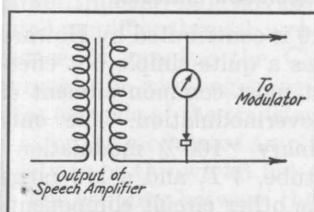


FIG. 15

The circuit diagram is shown in Fig. 16. Because no high-impedance choke was available at the time the amplifier was built, a 3-to-1 audio transformer with its primary and secondary windings in series was used for the plate load of the 57. Referring to Fig. 16, L and R₄ could be replaced by a non-inductive 100,000-ohm resistor, but in this case the plate supply voltage for the 57 would have to be increased to compensate for the $I R$ drop in the plate resistor ($.002 \times 100,000 = 200$ volts). The available gain would be materially reduced with the pure resistance plate load.

The odd voltage specified for the '10 was determined in this way: When the '10 has 425 volts (maximum recommended) applied to its plate, the rated bias voltage is — 39 volts with a plate current of .018 ampere. Since R₈ was calculated to provide a bias of 39 volts, the plate voltage must be 39 + 425, or 464 volts. This, of course, is not a critical value, because small variations in plate voltage produce corresponding changes in the grid bias, in the proper direction — an excellent reason for using the cathode-resistor method of obtaining grid bias.

The screen voltage may be obtained from a potentiometer across the B supply source if a good B eliminator is used. Because of the screen current characteristics of the 57, the use of a resistor in series with the high voltage supply may be employed for obtaining the screen voltage, *provided* the cathode-resistor method of bias control is used. This method of obtaining the screen voltage is not recommended, however, if the high voltage B supply exceeds 250 volts.

While on the subject of speech

amplifiers, the writer believes a few suggestions for the elimination of feed-back may not be out of order. Lucky is the amateur who hooks up his first double-button or condenser microphone amplifier and has no trouble with howling, sizzling, frying and singing disturbances!

Feed-back troubles are, of course, of two kinds — r.f. and a.f. Several suggestions for the elimination of the former are:

1. Use a well-shielded cable for the microphone leads; ground the shield.
2. Use a metal shield can, preferably sheet-iron, for the speech amplifier proper.
3. Place the speech amplifier as far away from the r.f. power amplifier as conveniently possible.
4. Use two .002 mica receiving condensers in series across the buttons of the microphone, the mid-point of the condensers being returned to ground with a separate lead.
5. Use *good* short-wave r.f. chokes in supply voltage leads.
6. Ground the core or shell of the filament transformer supplying the 57 and '10; and, if helpful, also that of the microphone input transformer, each with a separate lead. This applies mainly to unshielded amplifiers.

The elimination of trouble originating from a.f. sources may sometimes be accomplished by the following:

1. Use grid and plate filters or "de-coupling" devices (see Fig. 17) in the grid and plate circuits of one or all audio stages, especially the high-level stages.
2. Use separate "B" supply for preliminary and output stages. (This should, however, seldom be necessary.)
3. Use non-inductive carbon fixed resistors of 100,000 to 500,000 ohms across trans-

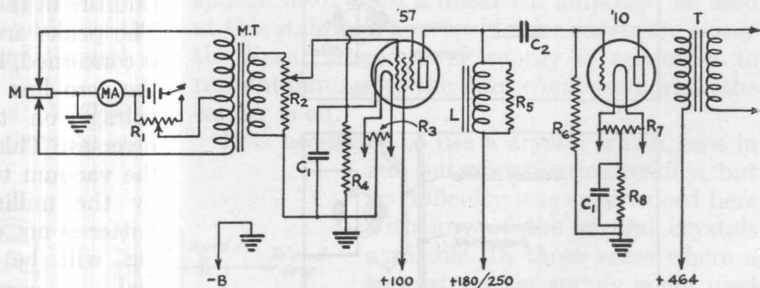


FIG. 16

CIRCUIT USING THE 57 AS A HIGH-GAIN SPEECH AMPLIFIER

M — Double-button microphone.

MA — 0-100 milliammeter.

MT — Microphone input transformer.

T — Output transformer for Type '10 tube.

L — 300- to 500-henry choke.

C₁ — 4- μ fd. 200-volt.

C₂ — 0.1- μ fd. 500-volt.

R₁ — 400-ohm potentiometer.

R₂ — 100,000-ohm potentiometer.

R₃ — 50-ohm center-tapped resistor.

R₄ — 1000-ohm 1-watt resistor.

R₅ — 250,000-ohm carbon resistor.

R₆ — 0.5-megohm leak.

R₇ — 100-ohm center-tapped resistor.

R₈ — 2170-ohm 2-watt resistor.

Filament supply for the '10 should be separate from that used on other tubes. An additional secondary winding on the filament transformer will serve.

former secondary windings, particularly on the high-level stage. The exact value of resistance for best results will depend upon the gain available and the gain desired. If too much voltage swing is delivered from any stage, the next stage may give trouble and require a resistance as low as 100,000 ohms across the secondary of its output transformer.

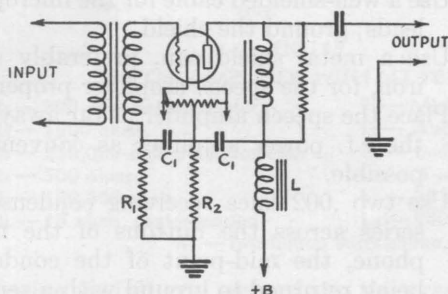


FIG. 17

GRID AND PLATE DE-COUPLING TO ELIMINATE A.F. TROUBLES

- R_1 — 50,000-ohm carbon resistor.
 R_2 — Usual cathode biasing resistor.
 C_1 — 4- μ fd. 250-volt condenser.
 L — A.F. choke; may be primary of suitable audio transformer.

Radio servicemen interested in portable public address amplifiers should find the 57 well worth trying for the microphone input stage.

— L. C. Waller, W2BRO

Curing Reverberation

The remarks contained in the following letter from Jack Paddon, Indianapolis, Indiana, are worthy of consideration by 'phone men. Not all the distortion in 'phone transmitters is attributable to the set itself. Witness the precautions

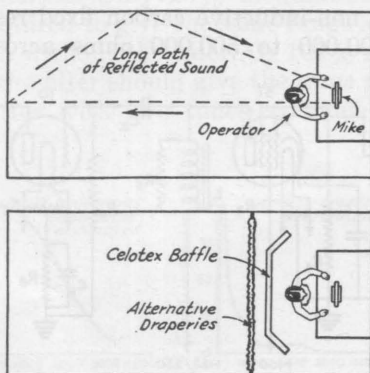


FIG. 18

taken in broadcasting studios to avoid reflection of sound.

"Have been listening to a number of 'phones and a great many of them have a fuzzy speech characteristic. After two years of recording studios it was a cinch to spot the trouble.

"One station, as an example, is located in a large empty cellar. As you know sound has a

velocity that is constant. The OM talks away at the mike and a split second later the mike picks up the same thing from reflection off the walls. This gives an out of phase condition between the source and reflected sound and hence the fuzziness.

"The cure is very simple. If you're a rich man, make a room out of celotex or some other sound insulator. Simpler yet, make a screen out of celotex boards or even simpler yet — swipe an old blanket or some kind of drape and hang it behind the operating position. See sketches in Fig. 18."

An Overmodulation Indicator

THE circuit of Fig. 19 is contributed by Howard A. Seyse, W8AGW, as a quite simple but effective indicator of that most common ailment of amateur 'phones — overmodulation. The only addition to the ordinary "100% modulation" circuit is a rectifier tube, VT, and a low-range milliammeter, M. The other circuit components shown in Fig. 19 are the usual modulation choke, dropping resistor and by-pass condenser, as well as the tank circuit of the modulated amplifier.

W8AGW explains the operation of the device as follows: With full 100% modulation the carrier will at certain parts of the audio cycle be reduced instantaneously to zero amplitude, but if the modulation percentage is greater than 100% these negative peaks or modulation "valleys" will be widened out, making discontinuities in the carrier and resulting in distortion. The peaks are cut off as far as useful radiation is concerned, but in effect they are pushed across the zero line and when that happens the plate voltage on the modulated amplifier actually reverses. This reversed voltage is rectified by the vacuum tube and the resulting current read by the milliammeter. So long as the transmitter is not over-modulated, however, no reading will be observed on the milliammeter dial.

Almost any type of tube can be used in the rectifier. Its plate-to-filament insulation must be good enough to stand the plate voltage on the modulated amplifier plus the modulation peak voltages, as must also the insulation of the filament transformer. Tubes of the 45, 80, 12-A, 10 and 50 types have been used by W8AGW with equal success. The milliammeter may be any low-range instrument, preferably having a full-scale reading between 1 and 25 milliamperes.

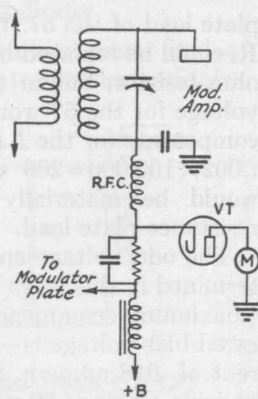


FIG. 19

SIMPLE OVERMODULATION INDICATOR

A Novel Class B Modulator

A CLASS B modulator using an ordinary power transformer for coupling between the modulator and Class C amplifier is being used successfully by W5ANB. The primary of the transformer is connected in series with the secondary, as shown in Fig. 20, thereby becoming an auto-transformer. This gives about the right impedance match, provided the transformer primary is poled correctly with respect to the secondary. The connections should be reversed when giving the system a trial to see which way gives the better audio power transfer. It is advisable to feed the modulated amplifier through a choke as shown in preference to running the Class C plate current through the coupling transformer because otherwise one side of the transformer will carry all the d.c. for the modulated amplifier and the system is likely to be thrown off balance.

* The coupling between the driver stage and the modulator also is of interest because it utilizes transformers originally designed for a different use and offers the opportunity of using a transmission line between the driver and modulator.

Automatic Break-In for 'Phone

THE many advantages of an automatic break-in for 'phone are apparent. With the transmitter operating only when the microphone is spoken into and the receiver coming on during the intervals in speech, a QSO may be had in the same manner as on a land-wire telephone. Since the transmitter and receiver work alternately, there is no blocking of the receiver, and any transmitter power may be used. Further advantages are that fading will be noticed while following each other's speech so closely, and no doubt will exist as to each other's reception as is experienced in the common type of transmission that takes from ten to twenty minutes before signing over. Also, QRM will be detected at once and give the stations being QRM'd a chance to get through a few words, at least.

The diagram of the system in use at W9CJU is shown in Fig. 21. The diagram is for the most part

self-explanatory. The '27 acts much the same as a volume-level indicator tube. In spite of the fact that two relays are used, all reports on the air indicate that in most cases even the first letter of the first word spoken is not lost.

The speed at which the transmitter is thrown

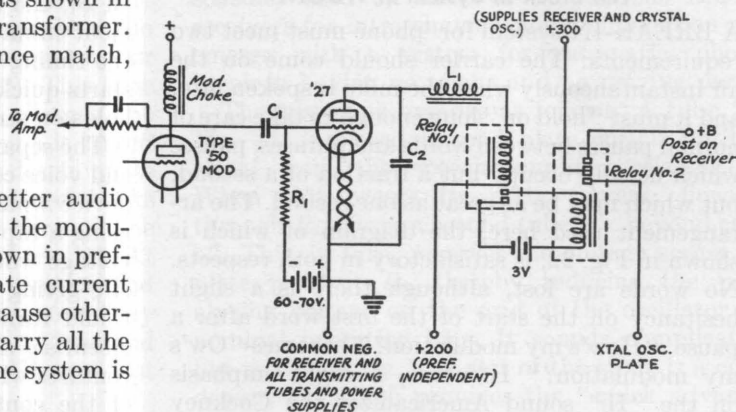


FIG. 21

BREAK-IN SYSTEM USED BY W9CJU

C_1 — .01 μ fd.

C_2 — 1 μ fd.

L_1 — 40 henrys.

R_1 — 50,000 ohms.

Relay No. 1 — 4000-ohm s.p.s.t. relay.

Relay No. 2 — Low-resistance relay, s.p.d.t., normally closed on the side connected to the plus B post on receiver. W9CJU uses an old telegraph sounder with contacts fitted on the armature and stop.

The control tube may be coupled to the preceding speech amplifier stage instead of to the modulator plate if desired.

on the air depends for the most part on the adjustment of the relay in the plate circuit of the '27 control tube. The speech amplifier and modulator voltages are on continuously as are, of course, the voltages, both plate and filament, of all of the r.f. tubes. However, since the r.f. tubes are biased to cut-off or nearly so in most set-ups, no plate current will be drawn by them unless the mike is spoken into. With a linear r.f. amplifier, as used at this station, a heavier bleeder resistance across the linear stage power supply is necessary to prevent damage to the filter condensers while the carrier is off.

It is necessary to use a crystal which goes in and out of oscillation readily, but no difficulty was experienced here with any of the several crystals available. In those cases where a separate power supply is not used for the crystal, this scheme will furnish one and perhaps lessen the tendency to frequency modulation. The lag or abruptness with which the crystal power supply (and carrier) is shut off is easily adjusted by varying the resistance in series with the 'C' bias in the grid circuit of the '27 control tube.

Most every 'phone station con-

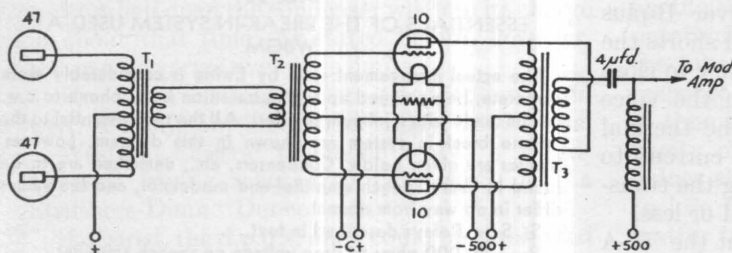


FIG. 20

CLASS B MODULATOR WITH AUTO-TRANSFORMER COUPLING

T_1 — Transformer designed for coupling a pair of Type 47 tubes to a 15-ohm load.

T_2 — Transformer designed for coupling a pair of Type 45 tubes to a 15-ohm load.

T_3 — Power transformer with center-tapped 1200-volt winding and 110-volt winding.

suggested. This system seems to work perfectly, and has the decided advantage that the time lag of the transmitter can be controlled to suit the operating conditions.

When the microphone is spoken into there is, of course, audio frequency energy in the line marked "To Modulator" in Fig. 23. A small part of this alternating current goes through the audio transformer and to the 245 tube (any two- or three-element tube will work as well). This tube acts as a half-wave rectifier and charges the 4- μ fd. condenser. The '27 control tube is biased to cut-off and normally no current is drawn by its plate. The charge on the 4- μ fd. condenser bucks the bias and allows current to flow through the relay winding in the plate circuit of the '27. At this stage the receiver is made inoperative and the carrier is thrown on the air. With a good relay all this takes place in approximately 1/20 second and the first part of the first word is not lost appreciably.

The adjustment of the 100,000-ohm variable resistor determines the length of time the charge will remain on the 4- μ fd. condenser after voice excitation ceases. The transmitter can be made to hang on between words up to several seconds if the operator wishes. Usually 1 to 1½ seconds will be found desirable. With the 100,000-ohm

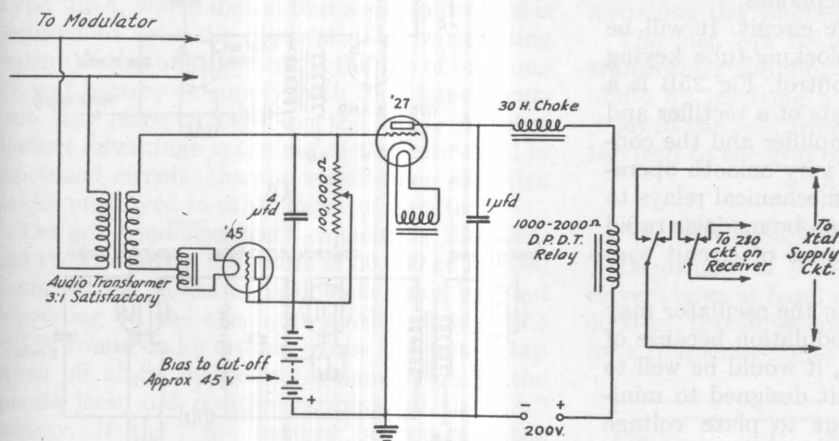


FIG. 23

'PHONE BREAK-IN SYSTEM USING A '27 CONTROL TUBE

resistor half open the condenser will lose its charge in about that time. As stated before, however, this can be varied over wide limits.

The following relays were tried and worked well: A Benjmain "Telicod" relay, 1000 ohms; a Western Electric telephone relay; a Ward-Leonard keying relay (110 volts a.c.); and a Struthers-Dunn "Dunco" relay.

If desired, the d.p.d.t. relay could be eliminated by substituting the crystal circuit or master oscillator at that point and working out some scheme to overbias the receiver when the carrier is on. This scheme, I understand, is being used by G. E. on their carrier-current transmitters. It is

much more complicated than the arrangement proposed here, however.

— Philip Stout, W4AAD

Electronic 'Phone Break-In

TAKING a lesson from the Rube Goldberg schemes used on some of the current B.C.L. receivers for intra-channel noise elimination we emerge with a system for automatic 'phone break-in having no relays and no moving parts.

The system is broadly as follows: A tube T_1 , Fig. 24, is biased beyond plate cut-off until a signal from the speech amplifier releases it. When this occurs its plate current, flowing through R_2 , biases a second tube, T_2 , beyond cut-off. This, in turn, removes the voltage across its plate resistor, R_2 , thereby reducing the paralyzing voltage on the grid of the oscillator to nominal operating bias. It sounds complicated but works neatly. The rest of the story is a condenser, C_2 , which provides the "quick advance and slow return" necessary to hold the works in during the interval between words and sentences.

Some details are: The coupling condenser C_1 is connected to the grid of a tube in the speech amplifier which has a normal swing of a few volts. The grid battery, B_1 , is adjusted to a sufficiently large voltage so that the grid of T_1 never goes positive and yet sufficiently small that the audio signal swings it distinctly below the minus four-volt mark.

The condenser C_2 must have low leakage. A good one will show less than .5 microamps when used as indicated. If, however, it has enough leakage to cause an appreciable voltage across R_2 , it is possible to add a reversed grid battery to tube T_2 so that the net grid voltage is zero when T_1 is removed. The hang-fire device works like this: When the grid bias of T_1 is reduced

by the signal, condenser C_2 discharges at a comparatively rapid rate through the tube, but when the tube is again biased high the condenser must recharge through R_2 . This takes a certain length of time which depends on the product of the capacity of C_2 and the resistance of R_2 . For the values shown it takes about four seconds for T_2 to lose 60% of its grid voltage. It is a simple matter to change the time constant should some modification be considered necessary.

The methods of turning off the receiver while the transmitter is on are numerous so this "is left as a problem for the student."

— J. O. Mesa, Waltham, Mass.

Another 'Phone Break-In System

ANOTHER break-in system requiring no relays and operating on a similar principle to the one described above is outlined in the following by H. D. Ashlock, W9TD:

The 'phone men may be interested in the method

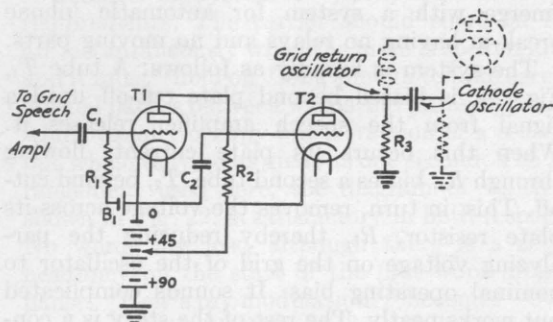


FIG. 24

CONTROL CIRCUIT FOR 'PHONE BREAK-IN—NO RELAYS REQUIRED

C₁— .1 μ fd.

C₂— 4 μ fd.

R₁— .5 megohm.

R₂, R₃— 1.0 megohm.

T₁, T₂— Type 56 tubes.

B₁— Not less than 4 volts.

used by the General Electric Company for several years to obtain single-frequency duplex operation of their power-line carrier telephones.

"Fig. 25A shows the basic circuit. It will be recognized as the familiar blocking-tube keying circuit arranged for voice control. Fig 25B is a later development and consists of a rectifier and filter between the control amplifier and the control tube. This circuit gives very smooth operation, and since there are no mechanical relays to introduce lag the operation can be made as rapid as desired by the proper choice of circuit constants.

"Since the plate voltage on the oscillator may vary considerably during modulation because of the drop in the control tube, it would be well to use a master oscillator circuit designed to minimize frequency variation due to plate voltage changes."

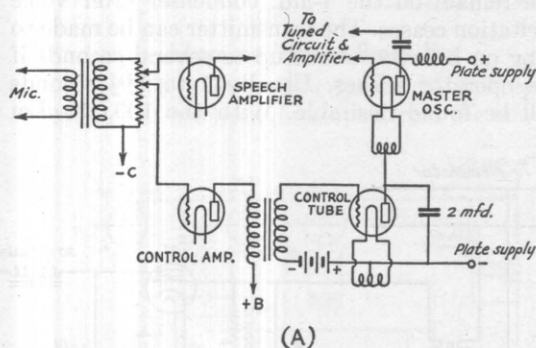
The constants in the rectifier circuit of Fig. 25B may be approximately those of C₂-R₂ in Fig. 24. Their sizes will determine the lag during which the carrier remains on after the voice has ceased.

Here are some helpful comments on the above system by Herb Walleze, W8BQ.

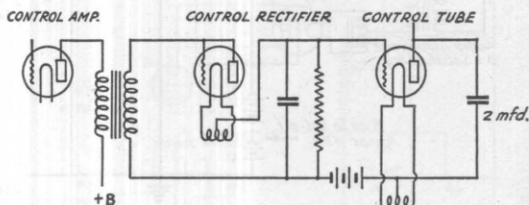
"The control tube should have the same rating as the tube to be controlled (it can be any stage

desired) and must have a separate heater or filament winding. In Fig. 25A if a good-sized paper condenser (1 μ fd. or more) is placed in series with the grid of the control amplifier, and separate 'C' bias provided this tube through a suitable audio choke, and correctly adjusted by experiment, the entire operation will be very much more smooth and the extra control rectifier shown in 'B' will be unnecessary. The control tube must be biased to cut-off (and that doesn't mean more or less) for smooth operation. All in all it is as simple and fool-proof a stunt as I have seen."

John Worisek, of Milwaukee, Wis., suggests that a nifty-looking microphone case can be made from one of those small electric clocks. Remove the works and insert the microphone. The cases are usually fixed up with rubber feet, which helps absorb vibration.



(A)



(B)

FIG. 25

MORE 'PHONE BREAK-IN CIRCUITS

The basic circuit is at A. The control tube performs about the same function as the keyer tubes described previously, but is operated by the speech amplifier. The circuit at B is an improvement over A in that the addition of the rectifier smooths up the operation and acts as a time delay to hold in the transmitter during short pauses in speech.

MONITORS AND FREQUENCY METERS

A Simple Monitor

A MONITOR is one of the most important and necessary bits of apparatus in the amateur station, yet it is surprising to find how many hams, especially beginners, do not possess this vital equipment. This condition is probably caused by the trouble and expense involved in making this little gadget, which always seems to present itself in the guise of a complicated mess of wires, chokes, condensers, etc.

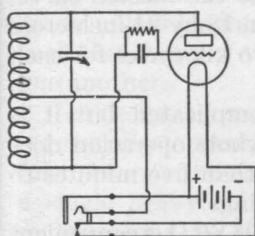


FIG. 1

Usually the simpler it is possible to construct any apparatus, the better will be the results obtained and the less trouble will be encountered in its operation. With this in view the circuit shown in Fig. 1 was laid out.

The tube employed a Type '12-A, which means that a six-volt source is required to light the filament. The outstanding feature of this arrangement is the use of only one six-volt battery to supply both the filament current and plate voltage for the tube. Another distinct advantage is the use of the entire coil in the tuned circuit, thereby eliminating an extra tickler employed in other types of monitors.

The grid condenser has a capacity of 250 $\mu\text{mfd.}$ and the grid leak a resistance of 50,000 or 100,000 ohms. Other values of grid leaks may be used depending on the constants of the circuit. The coil is wound on an ordinary tube base and a tap taken off at its midpoint for connection to the 'phone jack and positive terminal of the "A" battery. If the "A" battery be reversed the monitor will not function as the plate of the tube will have a negative potential. The 'phone jack is of the filament control type, and since the point of plate feed is at zero r.f. potential, no r.f. chokes are required.

The whole thing is shielded, but the battery may be left outside the can if it happens to take up too much space. It would be useless to give coil and condenser constants as any available parts may be used. However, a coil of about 20 turns and a variable condenser of 150 $\mu\text{mfd.}$ should tune to the 7-mc. band.

—Americus Molinara, W3AGJ

Switching the Monitor

QUITE a number of fellows are not using their monitors while transmitting because of the

trouble of shifting the headset every time they want to transmit. Consequently, if something happens in the transmitter they go blissfully along for some time before they discover it. Hence this suggestion for a simple switching arrangement.

At W3ADI the monitor is built right into the receiver case, the receiver itself being an a.c. outfit. The resistance coupling between detector and audio amplifier in the receiver lends itself nicely to switching between receiver and monitor with only a single-pole double-throw switch, as shown in Fig. 2. The resistor shown in the plate circuit of the monitor is an old headphone, although an actual resistance could be used if it does not cut down the monitor plate voltage too much. If an anti-capacity or jack-switch is used the extra contacts can be made to do other work also; for example, a single switch here takes care of the monitor filament circuit and operates a relay which starts the transmitter, as well as switching the 'phones from monitor to receiver.

The idea can be applied to receivers having transformer coupling between detector and first audio by inserting a coupling condenser (about .006) in the lead from the monitor and breaking the lead to the grid of the audio tube.

—Allan R. Muncey, W3ADI

The B. C. Superhet for Calibrating

THE owners of superheterodyne broadcast receivers have at hand a means of using the WWV 5000-ke. transmissions to obtain checks or points for a frequency meter calibration. These particu-

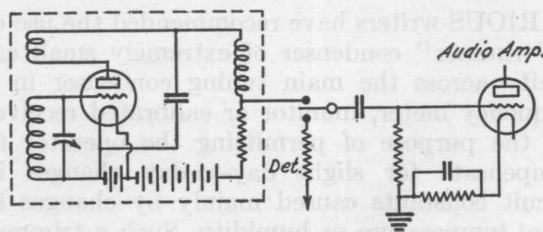


FIG. 2

MONITOR SWITCHING ARRANGEMENT

lar instructions are for use with a General Electric, Westinghouse or Radiola of the 80 series. Any other super in the broadcast band may be used by adding or subtracting the intermediate frequency from the dial reading, as only the oscillator frequency is really used. In the series 80, 175 kc. must be added to the dial reading to bring the oscillator harmonics to resonance with

the standard frequency signals. Since the transmissions continue for two hours a good check and recheck are possible. Two frequencies are used, and a third, while running into decimals, is useful as an approximate check.

To proceed with the check, tune the short-wave set to the 5000-kc. transmission and deadbeat the fifth harmonic of the oscillator, which is set at 1000 kc. (the dial reading will be approximately 830 kc. with this particular model); then, leaving the super strictly alone, change the short-wave set to deadbeat the oscillator harmonics at 4000 and 7000 kc. These are the extremes of the 3.5-mc. band. Next go back to 5000 kc. on short-wave set (incidentally oscillator creepage may be checked here) and deadbeat the 1250 kc. of the oscillator (dial reading approximately 1080) of the super with it. Now by retuning the short-wave set to 3750 and getting zero beat another point can be transferred to the calibration curve.

Starting over again with 714.285 as the super oscillator frequency the points 3571.428, 7142.857 or 14,285.7 may be obtained. By working back and forth many other combinations may be used to get other points. Only a very careful fellow should try it as the harmonic ratio is high.

In using this method the superheterodyne broadcast receiver must be in the same room. The closer the super is to the short-wave set the louder the signal received and the easier it is to get zero beat on the oscillator harmonics. The volume control can be turned all the way down and left there, however. If your super oscillator goes as low as 500 kc. every combination can be reached by working back and forth.

The sets should be warmed up for at least an hour if accuracy is desired, but a half hour will be sufficient for a fairly close check.

— James V. Gartland, W2BWR

Checking the Frequency Meter from WWV Signals

VARIOUS writers have recommended the use of a "trimmer" condenser of extremely small capacity across the main tuning condenser in a frequency meter, monitor or calibrated receiver for the purpose of permitting the operator to compensate for slight day-to-day changes in circuit constants caused mainly by changes in room temperature or humidity. Such a trimmer also is useful in the period during which the oscillator tube in a heterodyne frequency meter is warming up, if a signal of known frequency is available for checking.

A letter from C. H. Vincent, W8RD, who is a strong rooter for the trimmer idea, outlines his method of using the 5000-kc. transmissions from WWV every Tuesday between 2:00 and 4:00 p.m. and 10:00 p.m. and midnight, E.S.T. Here it is:

"In case you consider this worthy of noting for the benefit of the newer operators, I will

briefly outline the method used in checking against the 5000-kc. signal sent out by the Bureau of Standards.

"First: A d.c. receiver using two-volt tubes and having very little creep is first tuned to zero beat with the 5000-kc. signal.

"Second: A 2500-kc. inductance is then placed in the monitor, which is tuned to zero beat with the No. 1 receiver.

"Third: A second receiver which in this case happens to be a.c. operated, is tuned to 7500 kc., or to zero beat with the third harmonic of the monitor.

"Fourth: The second harmonic of the dynatron frequency meter, which operates on the 3500-kc. band, is then turned to zero beat with the No. 2 receiver and the trimmer condenser on the frequency meter so adjusted that the vernier dial of the meter reads the same as the master curve, which in this case is drawn on 18 by 24-inch cross sectional paper providing two kilocycles for each division.

"All this sounds very complicated but it is surprisingly easy, and the whole operation does not ordinarily require more than five minutes to obtain several accurate readings."

The extra receiver used by W8RD is convenient for checking back to make sure none of the settings have changed after the trimmer on the frequency meter has been set, but is not strictly necessary if the work is done carefully. The 5000-kc. signal can be picked up on the regular receiver and the procedure followed through as described above, plugging in a coil for 7500 kc. in the receiver for the third step. Even the monitor can be eliminated if the frequency meter covers the 1750-kc. band with a little leeway on the low-frequency side, although it is a necessity if the frequency meter is on 3500 kc., as it is in W8RD's case. If the frequency meter will tune to 1666 kc. its third harmonic can be set to zero beat with the 5000-kc. signal; the receiver should then be tuned to the sixth harmonic of the frequency meter, or 10,000 kc.; leaving this setting, the frequency meter is tuned to 2000 kc. and its fifth harmonic brought to zero beat with the receiver. The trimmer may then be adjusted to bring the 2000-kc. point to coincide with the calibration chart.

Many other combinations of harmonics can be worked out to give numerous points inside the amateur bands, so that a frequency meter can be fully calibrated as well as simply checked as described above. The WWV signals are especially useful for checking a previous calibration from Standard Frequency Transmissions, however, since only one point is required and nearly everyone can find it convenient to use the rather lengthy transmissions each week.

Minimizing Frequency Drift

THE information in the following letter from Lt. J. B. Dow, originator of the electron-coupled

oscillator, undoubtedly will be of interest to those who want to eliminate as much as possible the effects of temperature in oscillators for frequency meters, receivers, etc.:

"One of the most troublesome causes of frequency drift in any oscillator assembly is due to the effect of changes in temperature. Changes in temperature cause expansion and contraction which alter the amount of capacity and inductance in circuit. By the use of materials having a low temperature coefficient of expansion these effects may be reduced; however, in the usual forms of construction where aluminum shields, copper coils, conventional condenser designs and commonly used insulating materials are employed, the temperature coefficient of frequency of the circuit assembly cannot be depended upon to be less than 0.005 per cent per degree Centigrade unless by intent or accident the design is such that many of the contributory effects cancel one another.

"In designing oscillators with a view to reducing the effects mentioned, it has been found helpful to mount the entire oscillator assembly upon a single heavy sub-base of metal or insulating material and to fasten the sub-base at three points only, elevating it at these points so as to clear the neighboring shielding. The three points will be the vertices of a triangle. Such a mounting eliminates much of the bending of the sub-base that would take place were it held in position, say, at four points, and any distortion of the surrounding shielding acts in most cases merely to rotate the sub-base about an axis formed by one side of the triangle, without straining or disturbing the

relative positions of the various electrical parts which may be mounted upon the sub-base.

"The single-sub-base mounting also overcomes much of the trouble which is caused by expansion when parts of a precision oscillator are mounted upon two or more sides of a shielding compartment.

"Large panels as a rule distort more than do small ones and when large panels are employed, as in receivers, it is very desirable that the oscillator variable condensers, if mounted upon a sub-base, be not rigidly connected by shafts to the front panel as such an arrangement is almost sure to cause an appreciable frequency change whenever a sudden change in ambient temperature takes place. Many forms of flexible shaft-couplings are available or may be devised to overcome this trouble when such a design is dictated by the nature of the dial or assembly."

Dietzgen's "Perfect" cross-section paper is FB for that dynatron calibration curve. It has ten squares to the inch and comes in roll form, 20 inches wide, and as long as you wish. It can be obtained from almost any store handling draftsmen's supplies. — W9DVE

A method of using the 5000-kc. transmissions from WWV every Tuesday to check the frequency of crystals or calibrate frequency meters is described in Letter Circular No. 314, "Use of Standard Frequency Transmissions in Checking Standard Oscillators," published by the Bureau of Standards, Washington. Copies are available from the Bureau on request.

KEYING, REMOTE CONTROL AND INTERFERENCE ELIMINATION

Simplified Blocked-Grid Keying

ANOTHER variation of the many blocked-grid keying methods is shown in Fig. 1, suggested by Ben W. Sewell, W5ALP. The principle of any blocked-grid keying system is, of course, that when the key is open the grid bias on the tube is high enough to prevent the flow of plate current.

When the key is closed the bias should drop to the normal operating value.

This is very simply accomplished by the arrangement shown in Fig. 1. A "B" eliminator supplies the necessary blocking voltage. The total voltage required will depend upon the type of tube used in the amplifier, its plate

voltage, and the amount of excitation from the preceding stage. A voltage divider, R , is connected across the output of the eliminator, with the key inserted in series as shown. The position of the tap on the divider is determined with the key closed and excitation applied to the amplifier, and should be set at the point which gives the desired output under normal operating conditions. When the key is opened the bias rises to the full no-load voltage of the "B" eliminator, since no current can flow through R with the key open.

Since the current broken during keying is only that carried by the divider resistor, sparking and clicks are minimized. The higher the total resistance of R the less will be the current through it.

Anti-Yooping Devices

LOTS of notes on the air would be good steady d.c. if they weren't keyed — but they swoop and dive so enthusiastically when broken up into dots and dashes that they're harder to read than those r.a.c. buzzes and fully as annoying to listen to. Self-excited sets with well-filtered plate supplies are the chief offenders — and what good is a good filter if the signal is still hard to copy? The question is simply one of power-supply voltage regulation. *QST* has recently carried several good articles on steadying the output voltage by correct filter design, but there are also several mechanical methods that can be used to give the same effect and which do not require

special power-supply apparatus. The accompanying diagrams show three schemes of this sort.

Fig. 2 is used by Clifford Livingston, W6CQF, of Tucson, Arizona. A relay with two pairs of contacts, insulated from each other, is required. Two separate relays will do just as well, of course. One pair of contacts does the regular keying, while the other pair is used to short out the resistor R when the key is closed. The value R is adjusted so that, with the key up, the output voltage drops to the same value that it has when the transmitter is taking power. Generally this will require some thousands of ohms, since the only load on the power-supply with the key open is that furnished by the bleeder. Fig. 2 shows W6CQF's filter arrangement, but the scheme will work with any type of filter; a bleeder across the output is essential, however. If you have no plate voltmeter a milliammeter in series with the bleeder, as at X in the diagram, will serve the same purpose. Adjust R so the bleeder current is the same whether the key is open or closed.

A similar arrangement is used by Verdon Stones, W9BHF, Webster Groves, Mo. In this case, however, the compensating resistor is placed in the primary circuit of the plate transformer, as shown in Fig. 3. It is necessary, therefore, to get the filament supply for the rectifiers and r.f. tubes from a transformer separate from the plate-supply transformer, because the secondary voltage changes with keying. The practical working of the circuit is about the same as that of Fig. 2. Resistor R , which should be a variable affair with a total resistance of 1500 ohms or so, is adjusted so the output voltage of the rectifier-filter system is the same with the key open or closed. A relay with two sets of contacts may be

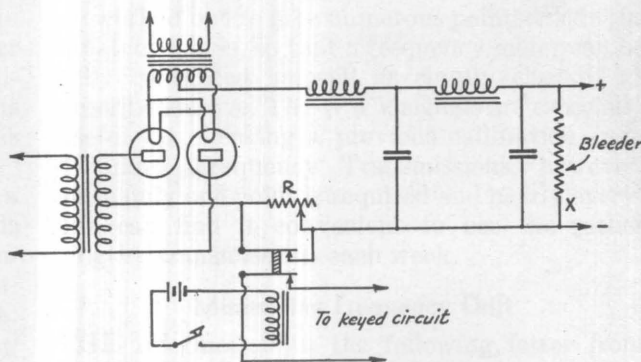


FIG. 2

substituted for the two relays shown, of course. A bleeder resistor and milliammeter may be substituted for the plate voltmeter, as suggested above. The whole story is in Fig. 3.

The third "anti-yooper" requires no relays, but utilizes a "regulator" tube which, when the key is up, takes the same plate current as the oscillator takes when the key is down. This system can be explained by reference to Fig. 4. With the key open, the regulator tube is self-biased by means of the variable resistor R_2 , which is adjusted to cause the tube to take the same plate current as the oscillator. Then when the key is closed the additional bias battery comes into the circuit and the current through the regulator tube drops to zero, provided the battery voltage is high enough. Bernard P. Hansen, of Woodmen, Colo., is responsible for this arrangement.

In Mr. Hansen's case the oscillator is a '45 and the regulator consists of three '26's in parallel. Resistor R_2 is a 3000-ohm variable, and the extra bias battery is a 45-volt unit. Adjustment is simple. Note the oscillator plate current with the key closed; open the key and adjust R_2 to make

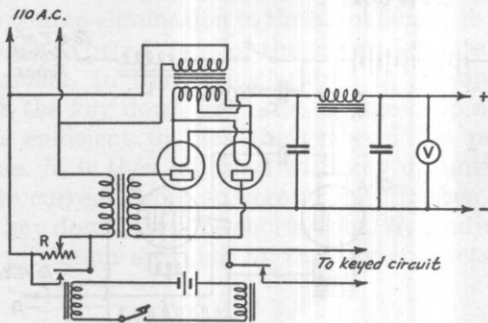


FIG. 3

the regulator tube current the same as that taken by the oscillator. A slight flicker in the meter reading with keying can be eliminated by a few final touches to all adjustments. In the original set-up R_1 was 100,000 ohms, and it was found that there was a tendency toward audio howling in the transmitter when the key was open. Increasing R_1 to 500,000 ohms cured it, however.

Higher oscillator plate voltages and currents will call for larger regulator tubes, of course. One or two Type '50's probably would be OK for an oscillator with one or two '10's. A larger bias battery would be required, of course.

Besides curing yoops these methods, because they keep the output voltage down to the full-load value whether the transmitter is taking power or not, give the filter condensers a new lease on life. With condenser input to the filter it is not at all uncommon for the voltage across the condenser terminals to go up 50% or more when the key is open if no attempt is made to hold the voltage down. The small cost of the extra apparatus is more than justified.

Operating the Keying Relay from the Plate Supply

HERE is an idea that is practical and should be welcomed by the all-a.c. ham.

The idea is one in which the keying relay is operated from the plate supply. With the approxi-

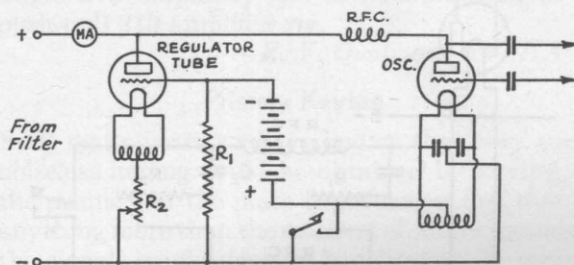


FIG. 4

mate values shown in Fig. 5 the current required to operate the relay was only a little more than two mils. The relay is an ordinary pony relay which was rewound with No. 40 d.c.c. wire so that very good action was obtained to the two mil drain. For some reason or other the key clicks disappeared and very stable operation resulted.

Using this with a voltage of about 450 from a rectifier using 216B tubes and a transmitter of the push-pull t.p.t.g. split stator type very good reports were obtained.

The relay works well even with a long remote control line as the resistance of any reasonable line is much less than that already in the circuit.

— D. D. Ritchie, ex-9CNK-W6AOG

Key-Click Preventer

IN FIG. 6 is the diagram of a key-thump filter used by C. C. Richelieu, W9ARE, which has proved its effectiveness in a number of different instances. W9ARE has this to say about it:

"The system has been used at W9ARE during the past two years with never anything smaller than a 50-watt tube in the output stage, running with varied inputs of from 100 to 250 watts, and it is the only system that has worked out satisfactorily. I have also given this diagram to numerous hams throughout the Middle West and to the best of my knowledge it has never failed to accomplish its purpose.

"This filter will change the adjustment of one's transmitter slightly if placed at the transmitter proper with lengthy leads run from the trans-

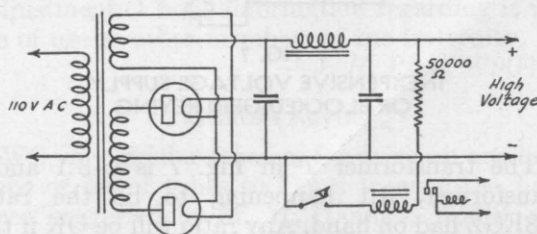


FIG. 5

mitter to the operating desk. To eliminate this drawback the filter should be placed on the operating desk right at the key, where it will have an appreciable effect on the transmitter adjustment. Also, the C_2 capacity can be increased on certain transmitters with marked improvement — all the

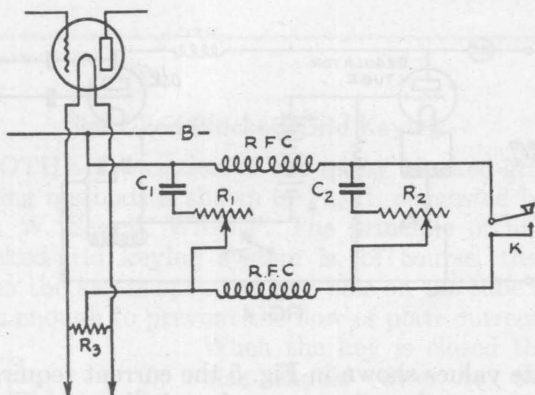


FIG. 6

KEY-THUMP FILTER WITH NO IRON-CORE CHOKES

RFC — 150 turns of No. 28 d.c.c. on $1\frac{1}{2}$ -inch form.
 C_1 — .5 μ fd. (must be rated to stand full plate voltage).
 C_2 — .006- μ fd. mica condenser.
 R_1 — 2000-ohm wire-wound variable resistor.
 R_2 — 50,000-ohm variable resistor, any type.
 R_3 — Filament center-tap resistor (may be c.t. of filament transformer).

way from .006 μ fd. up to 1 and even 2 μ fd. Considerable arcing at the key contacts will result from the larger condenser, but this arcing will have no effect in a BCL receiver because it is blocked by the r.f. chokes. In some cases the larger type condenser works much better.

Simple Method of Obtaining Blocking Voltage

BLOCKED-GRID keying is popular among amateurs, as the many ideas along this line published in *QST* prove. Here is another method of supplying the extra grid-bias voltage required by the system. It is contributed by Andy Hammerschmidt, W8EGZ.

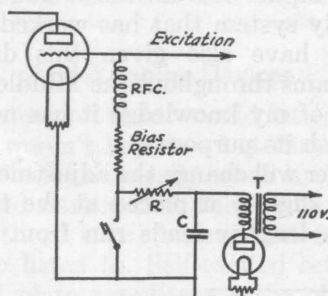


FIG. 7

INEXPENSIVE VOLTAGE SUPPLY FOR BLOCKED-GRID KEYING

The transformer T in Fig. 7 is a 3:1 audio transformer, 3:1 happening to be the ratio W8EGZ had on hand. Any ratio will be OK if the secondary voltage is high enough to block off the

r.f. tube when the key is open. The rectifier is a 201-A with the grid and plate tied together; here again any type of rectifier will serve just as well. Condenser C has a capacity of one μ fd., which is enough to keep the output voltage fairly constant. Ripple is of small consequence since the voltage from the "eliminator" is shorted out when the key is closed and therefore does not have a chance to get into the transmitter, hence an elaborate filter is unnecessary. W8EGZ uses a Bradleyohm variable resistor at R , which is in the circuit simply to prevent burning out the transformer when the key is closed. Anything in the neighborhood of several thousand ohms ought to be OK here. The blocking voltage with the key open will be something higher than the transformer ratio times the primary voltage; a 3:1 or higher-ratio transformer should be plenty to cut off a Type '10 or even higher-power tubes.

Although W8EGZ uses leak bias on his amplifier, the scheme can be used with any kind of bias supply so long as the key can be put in the grid-bias lead.

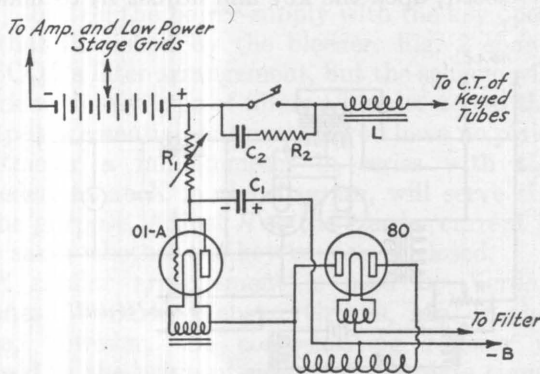


FIG. 8

BLOCKED-GRID KEYING WITH BIAS SECURED FROM OSCILLATOR PLATE TRANSFORMER

C_1 — 500-volt filter condenser, 1 μ fd. or more.
 C_2 — .5 μ fd., 300-volt rating.
 R_1 — Bradleyohm, 1000-100,000 ohms.
 R_2 — 350 to 500 ohms.
 L — App. 2 henrys. Secondary of bell-ringing transformer satisfactory.

Another Blocked-Grid Keying Arrangement

A BLOCKED-GRID keying system which does not require a separate source of blocking voltage and which permits grounding the filament transformers of the keyed tubes as well as the negative power supply line is shown in Fig. 8. This diagram shows the essentials of the keying arrangement used by Bob Eubank, W3AAJ. An additional advantage is that the current in the key circuit is small so that thump elimination is not difficult even with a transmitter of sizable power.

The principle of the keying scheme is the familiar one of adding high bias to the grids of the keyed tube or tubes when the key is open and shorting it out when the key is closed. In the case the additional or blocking bias is secured

from the transformer which supplies the plate power for the crystal oscillator. The regular Type 80 rectifier for the oscillator plate is shown for the sake of completeness. The blocking bias voltage is obtained from one side of the transformer and is rectified by a Type 01-A tube. Condenser C_1 acts as a filter; its chief purpose is to build up the rectified voltage to the peak value, however, since filtering in this circuit is not needed. W3AAJ likes the 01-A as a rectifier since it does not pass much current, which reduces sparking at the key. This one has been run on an unused 210 filament winding, showing that the filament voltage is not particularly critical.

The adjustment of the system is quite simple. With the key open, set R_4 for zero plate current on the keyed tubes. When the key is closed the extra bias is taken out of the circuit.

The inductance L , condenser C_2 and resistor R_2 constitute a thump filter which may or may not be found essential.

Another Keying Scheme

THE circuit of Fig. 9 is used at W8FHA to obtain automatic grid bias, blocked grid keying, and also thump elimination in the amplifier stage of an m.o.p.a. The r.f. part of the circuit is quite conventional. In the keying system R_1 is adjusted with the key down until the voltage drop across it is sufficient to bias the grids to the proper value. R_2 is then adjusted with key up until the plate current drops to zero or cutoff; then with the key down it will be shorted out. R_3 is adjusted for minimum sparking at the key contacts and

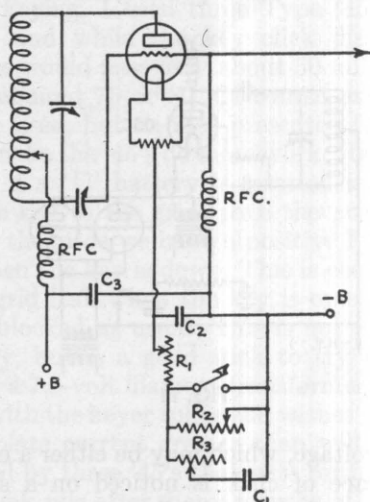


FIG. 9

A CIRCUIT TO OBTAIN AUTOMATIC GRID BIAS AND BLOCKED GRID KEYING

R_1 — 10,000 ohms, variable, 80-watt size.

R_2 — 100,000 ohms, variable, 50-watt size.

R_3 — 500 ohms, variable, 10-watt size.

C_1 — 1 μ fd.

C_2 — .01 μ fd.

C_3 — Usual plate by-pass condenser.

Other constants same as in ordinary amplifier practice.

also eliminates any stray chirps or thumps. C_1 is one microfarad and must be capable of withstanding the plate voltage as must also be by-pass condenser C_2 , which is .01 μ fd. When R_1 is capable of carrying enough current the thing also makes a beautiful rig to reduce power. This circuit has been in use for quite a while at this station on a single 210 amplifier, and is now working in a push-pull 210 amplifier rig.

— E. V. Qualman, W8FHA

Primary Keying

FOR many years we have known that very good noiseless keying could be obtained by keying in the primary of the plate transformer, but that if anything more than the smallest of filters was used the signals would develop bad "tails." In recent years, our oscillator circuits and equipment have been developed and improved to the point where frequency variation due to plate voltage change is negligible, especially in crystal transmitters. It follows that we should be able to use our present-day transmitters by keying in the primary, except, of course, when the same transformer supplies both plate and filament voltages.

By putting an adjustable resistor across the key (in my case a 100-watt electric light bulb) and a 1- μ fd. condenser across the primary of the plate transformer, the keying is well-nigh perfect. The resistor across the key serves to keep the transformer core partially energized, thus preventing surges. The 1- μ fd. condenser helps things in the BCL receiver. Using this system I am able to operate with 400 watts input without the slightest click audible at W9ML, located about 250 yards away. The BCL receiver complains vociferously when any light in the house is turned on or off but barely clicks when keying the transmitter. Decreasing the resistance across the key improves the click, or rather serves to eliminate it further, but the process can be carried too far and a back wave will result.

At the present time I use a crystal transmitter with two power supplies, one of which supplies the crystal and runs constantly while transmitting. The large power supply then supplies all doubler stages and the P.A. stage. This large power supply is keyed in the primary. I have also used primary keying with excellent results on a high-C Hartley oscillator with inputs up to 300 watts without any bad effects. It is the only system I have been able to find that is satisfactory in an apartment building and is not critical in adjustment. I hope information regarding it will be of use to other members of the fraternity.

— J. H. Platz, W9GY

Clickless Keying

TWO very similar schemes for using an auxiliary tube or set of tubes to key a transmitter have been suggested by W. H. Hannah, W2US, and C. W. Carter, W3AGT. In both cases installation

of the extra keying tubes has resulted in complete elimination of clicks.

A diagram of the system in use at W2US is shown in Fig. 10. The following letter from Mr. Hannah explains how it works:

"Clicks have long been a real source of trouble and worry to a great many of the amateur fraternity, especially in the more crowded sections

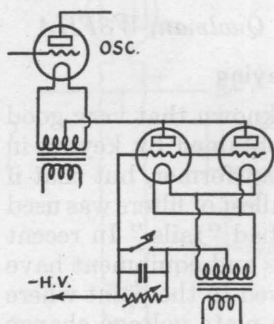


FIG. 10

are really surprising. All methods of keying that I had ever heard of were tried on my transmitter, which uses 852's in push-pull, and this was the only method tried that did the job.

"The circuit of the 'tube keyer' is submitted herewith and its simplicity is apparent. The tube used for the job can be any three element tube of not too high plate resistance. In my case two Type '10's in parallel proved adequate to pass the necessary plate current with a negligible drop in voltage to the transmitter. The resistor in the center tap lead can be of the variable grid leak type. The condenser capacity used was 1 μ fd., but a smaller value could be used advantageously. Another resistor could be added in series across the key to reduce sparking at the contacts, but I found that this was not necessary even though the discharge from the condenser was quite heavy. The insertion of the series resistor made no difference in the final result.

"It can be seen readily that the amount of current keyed is very small with this circuit arrangement. Owing to the fact that we are not keying the load but only a very small amount of grid current in the keyer tube we are well on the road to clickless operation. The resistance of the tube and the blocking of the grid by changing value of negative bias on the keyer tubes is responsible for the absolute cut-off of plate current. The proper value of resistance can be determined by leaving the key open and varying the resistance until the current through the resistance is of such value as to block the tube, cutting off the plate current to the transmitter.

"This method will key at high speeds and has been tested to well over a hundred words a minute, making perfect tape recordings. Broadcast receivers were operated in the same room from the same supply as the transmitter, turned on full volume between broadcast fre-

quencies, and there was not the slightest trace of a click.

"This is submitted with the hope that others of the gang will try it and find it as much of a godsend as I have. I thank the originator of this method, Mr. F. B. Kennell, R. C. A. Communications, Inc., Riverhead, N. Y."

W3AGT uses the diagram shown in Fig. 11, and has this to say about it:

"Referring to the diagram, consider that the control tube functions to open and close the center tap. When the key is depressed the 'C' bias voltage is shunted through the 100,000-ohm resistor. The control tube plate resistance is lowered giving the effect of closing the center tap. When the key is up the 45 volts from the 'C' battery is sufficient to increase the plate resistance so that in effect the center tap circuit is open.

"Using a 100,000-ohm resistor the amount of current handled by the key contacts is less than one-half milliamper. The $\frac{1}{4}$ - μ fd. condenser connected across the key contacts effectively prevents a slight click that might result from breaking even this small current.

"The control tube offers some resistance even with the 'C' bias removed, and the oscillator output is therefore decreased slightly over straight center-tap keying. To reduce this loss several tubes may be paralleled. As many as five or more tubes could be used on higher power transmitters. In our case two tubes give very slight loss, about 8%. The tubes used are of the 25-cent variety. The type '45 tube is used because of its low plate resistance when the grid bias is removed.

"The filaments may be connected either in parallel or in series depending on the available

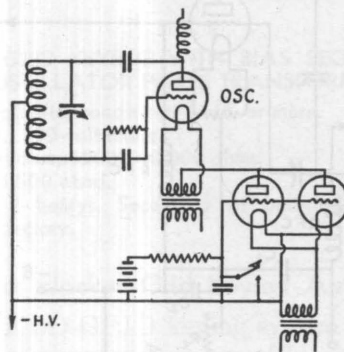


FIG. 11

filament voltage, which may be either a.c. or d.c.

"No trace of click is noticed on a sensitive broadcast receiver nearby."

Simplified Tube Keying

HERE is some dope on keying from Karl L. Wagner, W9HVU, who has improved on the circuits shown above to the extent of reducing the number of parts required to about the very minimum:

Fig. 12, eliminating all bias and condensers and

resistances, gives a performance equal to those of Figs. 10 and 11. In effect, this hook-up merely shorts out the bias and opens the circuit of the '45's at another place. As it works equally well without the '45 filament transformer being center-tapped, it resolves itself into merely substituting '45's for the original "c.t. — h.v." points and moving the original "key to c.t." connection to some point on the '45 filament winding.

"In short, instead of keying in the original center-tap, we merely substitute '45's for that and key in the c.t. of the '45's. What could be simpler?"

More About Keyer Tubes

ROY GALE, W1BD, gives a helpful suggestion for those who have had difficulty in getting one

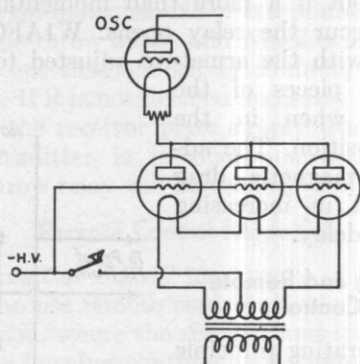


FIG. 12

or two tubes to pass the normal plate current for the transmitter:

"For keying, I used three Type '45 tubes in parallel, and while the key click disappeared, the tubes would pass only about 50 mills instead of the required 75 or 80. Of course, more tubes could be used, but an idea presented itself as to how to make the '45's do more work. Referring to Fig. 13, if a 'C' battery is inserted in the lead from the key to the grids with the positive side towards the grids we have a positive bias on the grids when the key is down. This is counteracted by the grid leak when the key is open, and the tube is blocked as usual. This is not a startling discovery, but is a good trick to try when one has only a 7.5-volt filament transformer available for use with the keyer tubes and wishes to operate with a plate current greater than will normally be passed by three '45's that were resting quietly in the junk pile after many months of service."

A V.T. Bug

AN electrically-operated bug key has as its chief advantage over the mechanical type the ability to make evenly spaced dots indefinitely, a feature which often is helpful when testing a transmitter or trying out key-click filters. Here is a stunt using a vacuum-tube oscillator to make the dots. It is an adaptation by Cristoph Schmelzer,

D4AAR, of a similar device originated by H. Evertz.

The transformer *T* in Fig. 14 is an audio transformer. The secondary usually is placed in the grid circuit of the tube and the primary in the

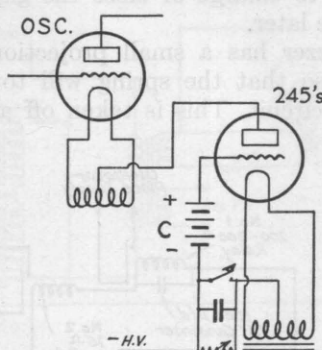


FIG. 13

plate, although it may be found that the other way 'round will work better. Condensers C_1 , C_2 and C_3 are 0.5 μ fd. each, while resistor R is a variable with a total resistance of about 100,000 ohms. The key itself is an ordinary sideswiper with the two stops insulated from each other. The relay should be a high-resistance affair which will work on a few milliamperes to permit using a tube such as a '27 or similar type. A high-resistance telephone relay will be OK in most cases.

The speed of the dots is controlled by the size of C_2 and the setting of R . With the constants given above D4AAR is able to control the dot speed within such limits that keying speeds between four and thirty words per minute can be obtained. The operation of the device naturally will vary with the type of audio transformer, which means that some experimenting with condenser sizes may be necessary. The "heaviness" of the dots can be adjusted by the spacing of the relay contacts and the spring tension. Care also must be taken to keep the generated voltage below the transformer breakdown voltage, which is best accomplished by making C_2 fairly large.

An Inexpensive Relay

A BUZZER acquired in pre-transmitter days for code learning, having outlived its usefulness as a

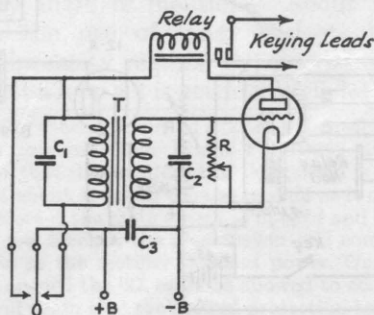


FIG. 14

tube is positively charged and the tube will continue to draw plate current until the charge on the condenser drops to such a value that the plate current is too low to hold in Relay No. 2, which then will open, disconnecting the plate supply from the oscillator and re-connecting the receiver plate supply. The time lag between opening the key and the opening of Relay No. 2 will depend upon the rate at which the condenser loses its charge and the sensitivity of the relay. This can be regulated within limits by the value of resistor *R*. The higher the resistance the greater the time delay. A 50,000-ohm variable resistor should give a fair range, but higher values may be necessary.

The two relays are of the type used on telephone switchboards, the coil resistance being 2500 ohms in each case. As the diagram indicates, No. 1 is a double-pole single-throw affair, and No. 2 is the same except that one set of contacts is reversed. If it is not deemed necessary to shut off the receiver plate supply when the transmitter is in operation a single-pole single-throw relay can be used for No. 2.

Remote Control Made Safe

THE circuit of Fig. 17 may prove of interest to those who use remote control. It is employed at this station, where the rectifier and transmitting tubes are burning continuously while operating. If the filament relay should become disconnected or stick the plate supply cannot be turned on, since the filament relay controls the primary supply to the plate transformers.

— J. H. Carr, W7OL

Remote Control

WITH the increasing popularity of remote control a simple system of control that not only is dependable and inexpensive, but easy to construct from stock parts, becomes desirable. The system to be described is not only cheap and fool-proof, but has given several years service controlling highly-inductive, heavy-current loads with no attention except the periodic cleaning of contacts.

There are three relays in the control circuits, a keying relay, a delay mechanism, and the necessary switches and current supply. The current supply used is an old "A" eliminator, which gives good service in spite of its variable voltage. The two relays, A (normally open) and B (normally closed), are rewound Brach Controlits, and Relay C, a 15-mil. affair, is made from an old filter choke. A '27 tube with its filament adjusted to heat a little slower than the 866 filaments is the heart of the delay mechanism. The circuit diagram, Fig. 18, is self-explanatory.

Operation is simple. To start, close switch A. This turns on the 866 filaments and the delay-tube filament. When the delay tube heats up and

draws current the relay, C, in its plate circuit turns on the plate supply transformer. When receiving close switch B. This opens the plate transformer primary, but keeps the rectifier filaments hot for immediate operation. To stop operation for some time, open switch A. This turns off the

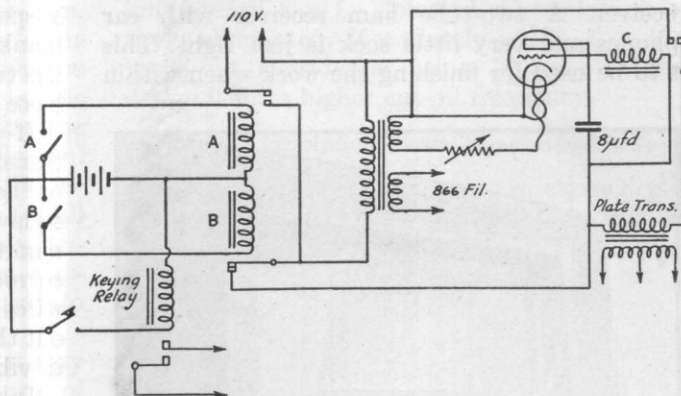


FIG. 18

REMOTE CONTROL SYSTEM WITH '27 DELAY TUBE

a.c. supply and allows the rectifier filaments to cool.

If by mistake you should start keying before the 866 filaments were hot or did anything else wrong, no damage would result because the plate power is not on until the rectifier is ready for it.¹

Last, but no least, it takes but a few minutes and a few cents more to make a neat job of a remote control outfit of this sort, and saves trouble from dust, mechanical damage, and Underwriters inspectors. The outfit illustrated in the photograph was made in one afternoon and is mounted in a 9" by 12" 4-inch steel cutout box, with all wiring in "BX."

— Ronald L. Ives, 32 Laurel Pl.,
Upper Montclair, N. J.

Running Down Local QRM

OCCASIONALLY we read of some ham who has a chronic case of power leak in his vicinity. Having been in the interference business for quite a number of years, I would like to give some light on the subject that never seems to have come out in print.

A lot is said about how to stop interference, but very little is mentioned about finding it without the use of fancy gadgets with high falutin' intensity meters. Or, maybe most of us think that a loop set is needed. Well, let's say here

¹ A similar scheme for using a '27 as a time-delay tube also has been received from Frank Fullaway, K6CFQ, who points out that the one defect of the system is that the '27 takes just about as much time to cool off as it does to heat, and therefore if the main switch is opened and closed again within a few seconds the plate power will come on at the same time as the rectifier filament power. Once the main switch is opened the '27 must be allowed to cool before the system will again give the desired protection to the rectifier filaments.

that intensity meters are OK but not at all necessary, and that the farther one keeps from a portable loop the better. There is only one place for the loop set and that is for locating high-line QRM. So if you have no nearby high tension lines, then just forget about the loop set.

Here's the dope. Get out the portable ham receiver. A two-tube ham receiver with ear 'phones and very little sock is just right. This is to be used for finishing the work when within

where the noise will suddenly disappear and then rise to normal. After these are passed, check again — and if the dial blanketing is narrower for the same intensity, then change your course until the noise is effective over a wider area of tuning. Keep the noise intensity as low as possible, using the volume control, until in driving a spot is reached where the dial is completely blanketed and no detuning can avoid QRM. Now the trail ends and not more than an hour should have elapsed on the first trial.

If you are out in the open near a pole having a transformer, try hitting the pole with a big rock or heavy wooden mallet. If the radio emits squawks in tune with the thumps, get a power man to climb the pole for loose wires and fuses or corroded lightning arresters. Shaking the guy wires will do the same thing, but it is hard to pick out the exact pole, since the whole system will be in vibration. But even this is enlightening.

In the event the noise comes from some appliance, get out the portable, attach about two feet of stiff wire to the grid end of the coil for aerial (20-meter coil OK) and you will be able to finish the job on the intensity principle. (Here we have the universal wavelength effect again.) In residences it may be better to get permission to check fuses, screwing them in and out to switch circuits on and off, and have a partner in the car blow the horn for the "off" signal when the noise quits.

For high-tension work use a good loop set. Keep the loop at right angles to the spans and every pole showing noise will give off a "buzz"

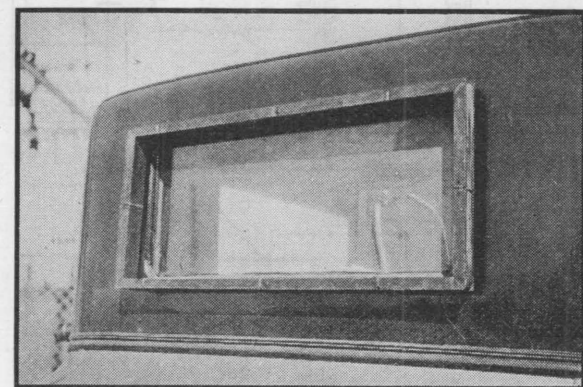


FIG. 19

THE LOOP FOR LOCATING HIGH-LINE INTERFERENCE FRAMES THE REAR WINDOW OF THE COUPE

fifty feet or so of the source of interference. But it is not used until the area has been definitely located. The reason that the little portable set is stressed at the start is to enable you to finish where you would otherwise give up the chase.

Now for the main and important part. It's a regular automobile radio. Some ham or friend perhaps has one, and usually has noise too, so is willing to help. Try to get a car radio that reproduces the high notes well, because the noise is much more pronounced on such a set. The next thing, a point generally overlooked, is to fix in mind that at the source the QRM is of "universal" wavelength. In other words, if the b.c. set shows little or none of the QRM that is heard on short waves, it indicates that the source is some distance away.

Now get the car radio going, and if you cannot hear the same noise that you hear on short waves (very unlikely) go to some suspected power lines until the noise is definitely heard and identified. Then *don't* do this: End up where it is loudest. You might drive for miles and find it loudest at the end of a line, perhaps a mile from the source, and miss the source entirely. This can happen even with an intensity meter. (Hi.) Remember the universal wavelength effect and, instead of keeping the dial at the loudest point of reception of noise, just detune from this point until the noise is barely audible. Try the other side of the peak, too, and check the width of dial tuning range blanketed by the noise. As you drive there will be noticed quite a number of dead spots

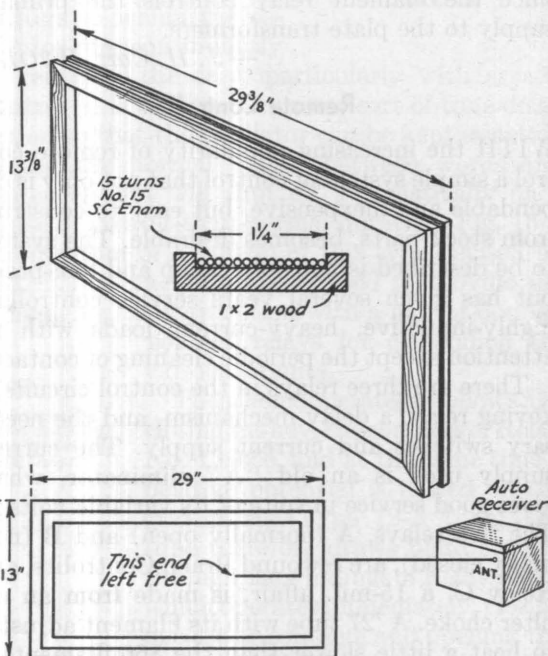


FIG. 20

THE LOOP USED FOR LOCATING INTERFERENCE FROM HIGH LINES

Mounted on the rear of the car, framing the rear window, it is normally at right angles to a line paralleling the highway.

without you hearing the noise of the whole line. Defective insulators are rare. Loose hardware is noisy (induction) and can be detected or temporarily stopped by tapping the pole with a wooden mallet.

The writer is using an aerial for the car radio that looks like a loop, but is only such when the receiver is tuned to the natural period of the loop. It is mounted permanently at right angles to the line of travel, being built around the rear window of the coupe. In order to get loop action in this way, one end of the winding is left free and the other goes to the aerial post of the radio (Fig. 20). The conventional ground is retained on the receiver, and this aerial gives good volume for all purposes. What the designers of short-wave converters have been trying to avoid in the resonance effects of unused inductances is used to advantage in this case.

To those seriously minded in this work, it may be stated that the loop contains 15 turns of No. 15 s.c. enameled wire in a groove $1\frac{1}{4}$ inch wide, size of the frame being 29×13 inches. The b.c. receiver chosen was a Silver-Marshall auto set because of its ability to bring out the highs extremely well. Resonance with this combination appears at about 1200 kc. A commercial portable was discarded for the final "touch-up" work in favor of the portable described in August, 1931 *QST* — thanks to W9CH.

— Robert B. Witschen, W9SV

Low-Pass Filters to Eliminate Interference

OPERATORS of amateur 'phones are more prone to have trouble with nearby BCL's than the c.w. man because it isn't possible to apply a click filter to a 'phone set. The following information from Millard E. Ames, W3BWD, may prove to be the solution of some of these problems:

"Being troubled with complaints from nearby BCL's, I have constructed a low-pass filter designed to cut off at 1600 kilocycles. Many amateurs may be interested in this untuned filter as it permits operation in all of the amateur frequency bands without resort to several wave-traps or retuning of a single wave-trap after each change of frequency. The circuit is shown in Fig. 21.

"It may be advantageous to shield the filter if it is in a powerful field. Condensers C are .0005 μ fd. apiece and the inductances were calculated from the formula:

$$L_1 = \frac{\left(\frac{1}{\pi f}\right)^2}{C}$$

"The inductance L_2 should be one-half of the inductance L_1 , which was calculated from the formula to be 79 microhenries. (These values are for terminating impedances of 400 ohms, probably a fair estimate — Ed.) Using a coil form $1\frac{5}{8}$ inches in diameter and No. 24 d.s.c. wire, L_1 has 54 turns and L_2 33 turns. Of course the con-

densers and coils need not be exact in these measurements.

"This filter seems very effective in eliminating eighty-meter 'phone signals from a broadcast receiver here at W3BWD. The receiving antenna runs very close to the Zeppelin feeders and not more than ten feet from the flat top. No form of interference can be detected. Cross-talk is entirely eliminated. It certainly works FB. Amateurs not considering using 160 meters could design it for a higher cut-off frequency."

Curing Interference with Telephone Lines

PROBABLY a good many hams, especially operators of 'phones, have had trouble with the

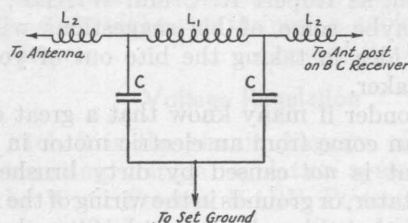


FIG. 21

land 'phone lines picking up their transmissions and causing interference. W. H. Carter, Jr., W5ANW, brings to light a little-suspected cause of such interference:

"The neighbors in the vicinity of W5ANW have been bothered at times with the telephones picking up the transmissions from this station. The telephone company has had several men out here working on the problem and have not been able to correct it. Telephone lines are run by the back of the shack about 7 feet from the transmitter and about 100 feet from the flat-top antenna. Tests were run on this cable, a 51-pair line, and the signal from W5ANW was heard on all of them regardless of how well the cable sheath was grounded. The drops were removed in the tests so that they could not have contributed to the difficulty.

"After the telephone company had given it up as a bad job and were to wait for a man to get back to town to work on the problem, I decided to try a remedy myself. I discovered the cause and correction. The mike on the telephone instrument was acting as a detector and the cable pair was picking up sufficient energy through the lead cover to give a loud signal in the headphone. The trouble can be corrected in three ways: first, by winding a copper cable around the telephone cable and grounding it off at both ends; second, by isolating the telephone disturbed through a repeated coil and furnishing a local mike battery; third (and the easiest method), by simply inserting an aperiodic r.f. choke coil in the "tip" side of the line at the instrument. This choke can be screwed to the terminal strip in the bell box and is easy to install. It is not at all critical as to

value but if properly designed will completely eliminate *all* interference. The choke *must* be placed in the tip side of the telephone line or it will not be effective.

"I have heard of several cases like this one which were not corrected because the solution could not be discovered."

Electrical Interference

"STATIC" set up by electrical machinery is often one of the worst enemies to decent reception, and it is not always easy to cure even when the orthodox methods, which seem to be logical enough, are applied. Some of the noise is only indirectly caused by the appliances which may be under suspicion, as Rupert R. Crum, W7ADF, points out. Maybe some of his suggestions will give you an idea in taking the bite out of your pet noise-maker.

"I wonder if many know that a great deal of noise can come from an electric motor in operation that is *not* caused by dirty brushes, bad commutator, or grounds in the wiring of the motor, and also that this noise cannot be filtered with all the condensers and chokes in the country.

"One common source of such noise is a static charge built up on the motor frame by friction from belt slippage and also by induction from the motor field winding. To create a noise this charge may be leaking to ground through the motor base bolts by potential discharge or through a vibrating ground contact. Such a contact or vibrating ground may exist a good many feet from the actual motor location, or may be in the conduit joints of the building wiring. It may be a leak to actual dirt ground through the floor or through water piping as far away as the *third* floor of the building.

"When looking for these grounds, shake *all* water piping and gas piping, and even the stove-pipe if one is around. The number of loose joints that can be found is surprising, and at times to all appearances the offending pipe is not even close to an electrical circuit. I know of one case where the radio receiver in question gave an excellent imitation of Niagara Falls when the people in the neighboring house drew a glass of water, yet the neighbor's house was at least 150 feet away. This was cured by moving the radio ground-rod about four feet farther out in the yard.

"To be noisy, a conduit does not have to have a motor on the end of its service wires — all it needs is an electrical load. The heavier the load the worse the noise, usually. Conduit carrying higher voltages than normal is also more likely to cause noise; taking 110 volts as normal, 220- and 440-volt lines are proportionately worse offenders.

"Another thing: the grounding terminal picture on a filter diagram means grounding on the offending motor's *frame*; after this is done run another wire to a water pipe or driven ground if you wish."

BCL QRM from 5 Meters

THE following information was gathered after many experiments with BCL interference caused by 56-mc. 'phone stations to receivers located on the same premises as the station but working from separate power supplies. I am passing it on with the hope that it may help others.

When the antenna was connected to the b.c.l. set the interference covered the entire broadcast band and did not appear to be tunable, but disappeared when the antenna was disconnected. Various methods of elimination were tried, including grid suppressors and by-pass condensers, but while the interference disappeared so did the broadcast program.

Finally a wave trap using a 20- μ fd. midget variable condenser shunted with three turns of bus bar wound to a diameter of $\frac{1}{2}$ inch with turns spaced the diameter of the wire was tried and when tuned to the frequency of the station completely eliminated the interference.

This trap was inserted in series with the antenna lead-in of the b.c. set, but the lead from the trap to the set, while only 6 inches long, was sufficient to pick up the interference. This lead should be shielded and the shielding grounded to the chassis of the set.

This idea was tried on a completely shielded 10-tube receiver of the tuned-r.f. type and it completely eliminated all interference, except that on WABC it appeared to ride in on the carrier. However it was just barely understandable when no modulation was applied to the carrier of the b.c. station.

— C. M. Spengler, W2BXW

IMPROVING THE POWER SUPPLY

A Handy Power Pack

THE amateur who likes to experiment with various types of receivers, "trick" oscillators, small amplifiers and any other set-up which requires a maximum plate voltage of about 300, will find this small unit a most useful addition to his

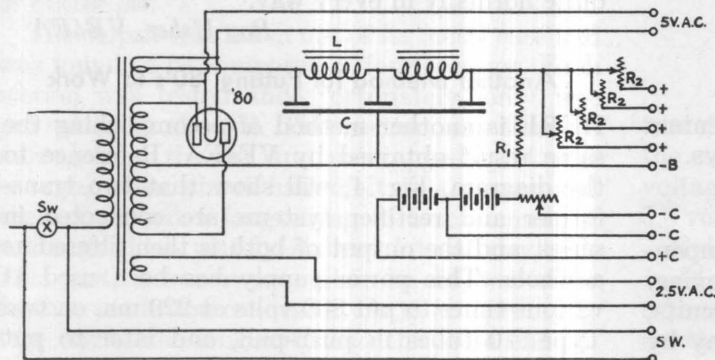


FIG. 1

"B" POWER PACK WITH ADJUSTABLE VOLTAGES

- T — Transformer of the type used in broadcast receivers; filament windings of 2.5 and 5 volts, plate winding 300-350 volts each side of center-tap.
 C — Three-section electrolytic condenser, 8- μ fd. each section.
 L — Double-section 30-henry choke.
 R₁ — 15,000-ohm bleeder resistance.
 R₂ — 50,000-ohm variable resistor (Bradleystat E-5).

equipment. It uses a Type '80 rectifier tube, a General Electric double choke, Mershon electrolytic condenser, and an Electrad 15,000-ohm tubular resistor across the line to hold the voltage constant. The transformer used is a Thordarson.

As shown in Fig. 1, the hook-up is that of a standard full-wave rectifier type power pack up to the bleeder resistance. The four Bradleystats are of the E-5 type, 50,000 ohms each, enabling one to obtain unusually wide variations of voltages.

Provision is made for the incorporation of a "C" battery in the can. A "C" battery was deemed advisable since most of the a.c. hum picked up in a receiver comes from the grid circuit, and the use of battery bias will do a lot toward eliminating this. The high tap of this battery is also shot through a Bradleystat of the same value so that one may find the best working bias.

The filament leads from the transformer, 5 and 2½ volts, are brought out to binding posts on the panel as are also the switch leads from the transformer primary, making it convenient to turn the pack on and off from the set.

All parts are mounted in a metal can 10x10x5 inches (the can used was one of those large high-

voltage condenser cans). One side of the can is chopped out and a bakelite panel mounted instead. All the controls and binding posts are mounted on this panel.

All in all this makes a neat looking, compact substitute for the usual pile of junk that the amateur uses for a "B" supply and can be tucked away, once the voltages are set, and the leads brought out through a cable to the receiver.

— Leonard B. Gallup

Voltage Regulation

FIG. 2 is the circuit diagram of an interesting voltage regulation system used by W. C. Forrest, W1BU, Poynette, Wisconsin. When correctly adjusted the plate voltage on the Type '10 crystal oscillator is maintained constant in spite of large fluctuations in the power supply voltage, which is nominally 1200 volts.

The operation is about as follows. The two Type '50's are biased so that with normal supply voltage they take normal plate current, of approximately 40 to 50 milliamperes each. With this load plus the normal load of the Type '10, the 10,000-ohm resistor plus the resistance of the 60-watt lamp drops the voltage to the value desired on the plate of the '10. The "C" battery voltage is adjusted to reach this condition, the value in this case being about 400 volts. Under

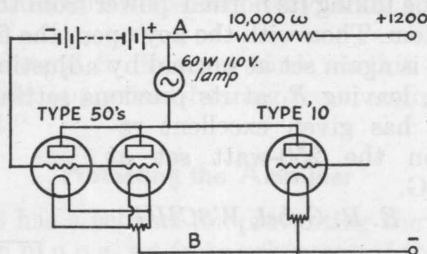


FIG. 2

normal conditions, then, the bias voltage on the grids of the '50's is the "C" battery voltage minus the voltage drop between A and B. If the plate supply voltage should increase the current also will increase, which makes the voltage drop between A and B greater and consequently the bias voltage on the grids of the '50's less. As a result the '50's take more current, still further increasing the voltage drop through the lamp and lowering the plate voltage on the '10. By the proper choice of "C" battery voltage and the values of the two resistors the plate voltage on the '10 will remain

constant with changes in plate voltage of the order of 50%.

A voltage-regulation system of this sort also has some of the characteristics of a filter, since it will smooth out rapid pulsations in the same way as a filter condenser. A disadvantage is the large "C" bias battery required. Many variations

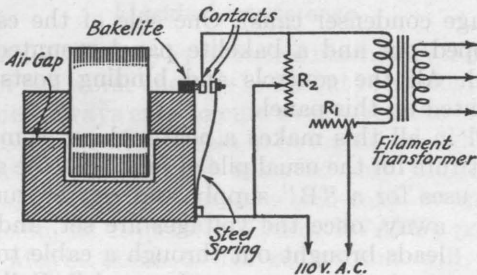


FIG. 3

could be worked out, however, and experimenters may find the idea useful in a variety of ways.

Filament Voltage Compensation

FIG. 3 illustrates a simple method of compensating for filament voltage drop when keying. Most amateurs use chokes in their filter circuits, and the filter choke is put to use as a relay by clamping or bolting a piece of spring steel on the side of the core, as shown in Fig. 3. The free end of the spring carries a contact. A small piece of bakelite, also furnished with a contact, is fastened to the core so that the two contacts are opposite each other. The magnetic pull of the core is sufficient to close the contacts when the set is keyed.

The operation of the system is quite simple. With the key closed (which also closes the relay contacts), rheostat R is adjusted to put the correct voltage on the filament. The plate circuit should be taking its normal power from the rectifier system. Then with the key open, the filament voltage is again set at normal by adjusting rheostat R_2 , leaving R_1 at its previous setting. This scheme has given excellent results on the 250-watt set at W3CHG.

— E. R. Gabel, W3CHG

Getting High Voltage from the '80

MANY amateurs are undoubtedly limited to low power owing to the high cost of Type '81 tubes. However, there is another way in which one or two Type '10 tubes can be supplied with plate voltage—and at a low price. This consists of four Type '80 tubes connected in a bridge rectifier circuit. The two plates of each tube are connected in parallel. Of course, three filament windings are required, but

on the other hand a center-tapped plate transformer is not necessary. This means that a transformer designed for use with Type '45 tubes can be used by connecting to the two outside ends of the winding (disregarding the center tap). Such a transformer usually gives from 300 to 400 volts each side, and when used in this way usually will deliver about 65 mils without overheating.

This system has been used to supply plate voltage for an m.o.p.a. with a 211-D amplifier and has given excellent results. The measured plate voltage was about 825 at 125 mils. The transformer used gave 750 volts r.m.s.

No signs of ionization or overheating are apparent in the tubes, and they seem to be operating quite normally in every way.

— Roy Usher, VE4EA

Another Method for Putting '80's to Work

HERE is another method of accomplishing the same result obtained by VE4EA. Reference to the diagram, Fig. 4, will show that two transformer and rectifier systems are connected in series, and the output of both is then filtered as a whole. This power supply has been used at various times to put 800 volts at 220 ma. on two Type '10 tubes in push-pull, and later to put 1000 volts at 175 ma. on the plate of a 50-watter.

T_1 and T_2 are both transformers giving 400 volts each side of the center tap on the high voltage winding and rated at 350 ma. The filament windings are 5 volts. The taps on the primaries are used to control the output voltage. These particular transformers have an electrostatic shield, which, when grounded, proved to help greatly in clearing up the noise from the transmitter. The tubes are Type '80's. The two tubes in parallel, in addition to supplying more current, give a lower voltage drop through the rectifier and improve the regulation. L_1 is a 30-henry, 200-ma. choke. The filter condensers are 8- μ fd. electrolytics. The bleeder resistor, R , is 50,000 ohms. The actual measured output of this power

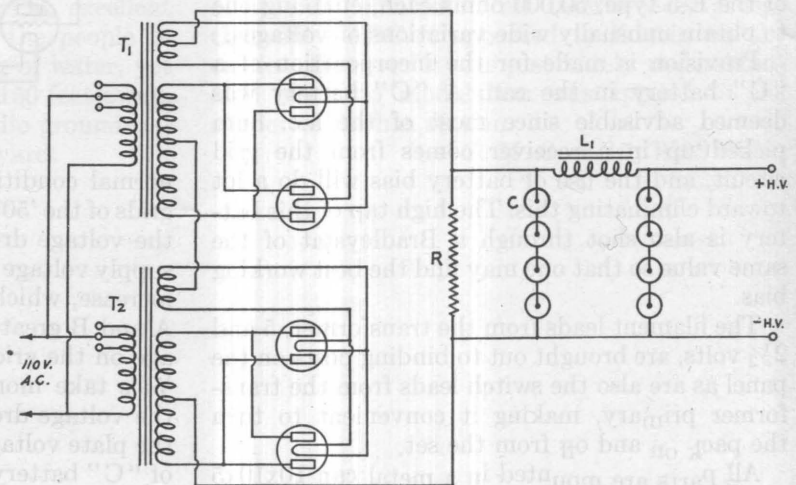


FIG. 4

supply with the primary taps set to give highest voltage is 1050 volts at 200 ma. The rating of the tubes is not exceeded with the primary taps set to correspond with the line voltage, and the tubes seem to have a long life. Mine have been used about 800 hours and still test OK.

— Frank M. Davis, W9FVM-W9CON

Blown-Out Filter Condensers

SEVERAL articles have appeared regarding the possible repair of blown-out filter condensers. Here's another one. Recently the writer had the age-old (but still sad) experience of blowing a filter condenser. A method of repair was at once sought, for they are not given away with a pound of butter yet.

The culprit was taken out of its metal case and was found to be composed of four sections. Each section was tested and, fortunately, only one proved to be shorted. This section was then removed from the tar and unwrapped, and sure enough, when about half of it was unwrapped there appeared a long string of black smudges, some of which plainly showed lots of daylight. This part, it was at once plain to see, was of no further use in the condenser. So it was promptly torn out of the long strip and the loose ends of the tinfoil were separated from the wax paper covering for about six inches. They were then spliced together, using the six inches for the splice, just laying the tinfoil to tinfoil and wax paper to wax paper. Care was exercised to maintain the proper continuity of the conductors and the splice was firmly held together until there were several layers rewrapped over it.

The experiment was then put back together and the tar remelted, (and this condenser has functioned as well as ever for about a year. The above scheme might not work in all cases, but it may keep some poor ham from crying all night over a blown filter condenser when it might be similarly repaired.

— K. M. Isbell, W6BOQ

Better Filtering

MANY amateurs do not realize that there is often a real advantage in the use of tuned filter circuits for power supplies, since the amount of inductance and capacity necessary for a given degree of filtering is much less than that required in the more common filter arrangements. Here is some interesting information from Franklin Offner, W8AJZ-W9FTO:

"Recently I was working with W3AH, measuring the ripple voltage from various condenser-choke combinations. The ripple voltage was measured with a one-ma. rectifier-type voltmeter in series with a 2- μ fd. condenser. Our results, though only an indication of what can be done, lead me to believe that hams can do a lot better than merely pile on the microfarads and henrys in single or multiple section filters.

"We tried various combinations of the following: a 1- μ fd. condenser, a 2- μ fd. condenser, an RCA double 30-henry 80-mil choke and a couple of Stromberg-Carlson 250-mil 4-henry chokes (43c each) all used simply because they were available. With the best combination of chokes in the brute-force arrangement using 1 μ fd. on the input and 2 on the output, the ripple was around 6 volts, from a 550-volt (each side)

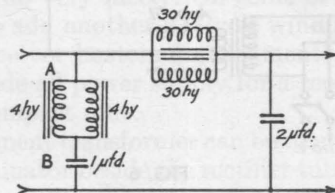


FIG. 5

transformer, full wave, at 100-mil load. Then the circuit of Fig. 5 was hit upon, and the ripple voltage output from this combination was only 0.8 volts.

Evidently the two 4-henry chokes and the 1- μ fd. condenser were series resonant, since either adding to or subtracting from capacity or inductance caused a large increase in ripple output. It is probable that by varying the values of the condenser and choke in the series resonant portion better filtering would be obtained and also by more careful adjustment of the inductance of the choke, "A," possibly by using one with variable air gap, in order to make the combination resonant at exactly 120 cycles. Obviously the choke used at "A" may be of low current-carrying capacity, since it carries no d.c. This point is the big advantage of this circuit over one using tuned traps in series with the output—that is, the chokes carry no d.c. and therefore their inductance does not vary with the load drawn.

"We intend to do more work on this circuit, and would appreciate hearing from anyone else trying it."

Protecting the Amplifier

W6CKS has a scheme for preventing the amplifier in an m.o.p.a. set from going west if the plate circuit should be inadvertently closed when the bias voltage is off. It is particularly applicable to those transmitters in which separate plate supplies are used for the oscillator and amplifier and in which the bias for the amplifier is obtained from a voltage divider on the oscillator plate supply.

A wiring diagram is shown in Fig. 6. Two relays are necessary, one to close the high-voltage supply in the oscillator circuit and the other for keying the amplifier center tap. When switch *S* is closed Relay No. 1 closes and bias voltage appears on the amplifier grid. The amplifier may then be keyed. So long as *S* is open, however, it is

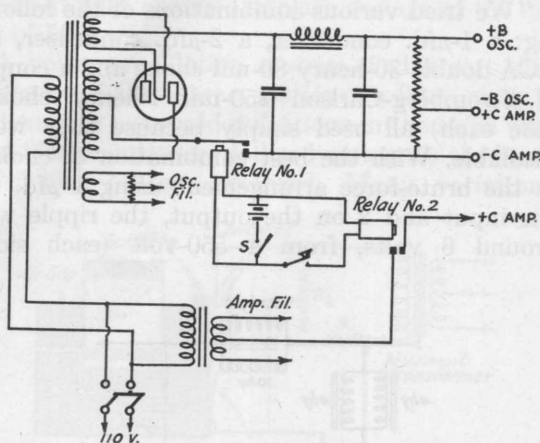


FIG. 6

impossible to close the amplifier center tap and thus no plate voltage can be put on the tube.

The power line switch should be arranged to turn on the oscillator plate supply at the same time the amplifier filament goes on.

An Electronic Circuit Breaker

THE overload relay arrangement shown in Fig. 7 was suggested by W1BHH, who writes as follows concerning it:

"During some 5-meter work, my transmitter had to run for long periods without anyone watching it. At one time it developed a short circuit somewhere and ruined the rectifiers. To prevent further trouble of this sort, I used the idea shown in the accompanying diagram.

"When a short develops, the 201-A tube lights up and current flows through the relay, breaking the circuit. This also happens when the tubes stop oscillating or when a spark jumps across the leads of a filter condenser."

The relay should operate on fairly low current — 50–100 milliamperes — and should be of the normally closed type. After once operating it should not close again unless reset by hand. Otherwise it will go on and off automatically something in the manner of a buzzer as long as the overload persists. This idea should not be used on voltages much over 500 because the insulation in the '01-A is likely to break down.

Operating Full-Wave Mercury Vapor Rectifiers with Plates in Parallel

IN ATTEMPTING to use both plates in parallel in 82 and 83 rectifiers, it is sometimes difficult to get the load to divide evenly between the two halves of the rectifier. Generally one of the plates will take all the load and the other will not "start." This is almost certain to happen if the positive lead is taken off one side of the rectifier filament transformer.

This can be corrected in a number of ways. A center-tap on the filament transformer often will do it, but the tap must be in the electrical center. Various experimenters have reported that center-

tap resistances like those used in receiving sets will cause the load to be divided evenly between the two plates if connected across the filament transformer or if connected between the two plates. The positive high-voltage lead comes off the center-tap in the first case, and the a.c. is fed to the center-tap in the second.

Fig. 8 shows a scheme used by W6CKS which is a handy one to use. An old filament rheostat (can be picked up for a few cents at almost any radio store) is connected between the two plates, and the resistance varied with the load connected until both plates show equal blue. A low-resistance potentiometer with the ends connected to the plates and the a.c. brought in through the arm could also be used.

An Arc-Tipping Scheme

HERE is another idea to add to that endless chain of foolproof automatic mercury-arc tipping systems. The diagram is shown in Fig. 9.

The keep-alive circuit is standard and need not be discussed. The arc is weighted so that it

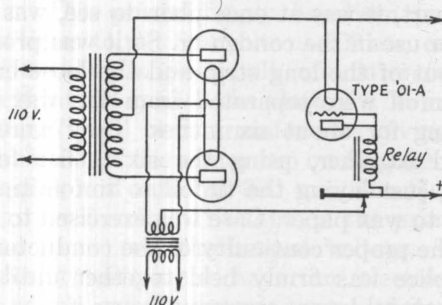


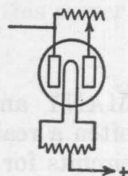
FIG. 7

"idles" in an upright position with no contact between the two pools. Across the two pools is connected a relay in series with a resistance. The tension and spacing of the relay and the value of the resistance are adjusted so that the relay

FIG. 8 CIRCUIT FOR BALANCING CURRENTS WHEN OPERATING BOTH PLATES OF MERCURY VAPOR TUBES IN PARALLEL

will operate on the output of the keep-alive rectifier when the arc is not lit but will not operate on the 14-volt drop across the pools when the keep-alive arc is operating. The contacts of this relay make and break the a.c. from the keep-alive plate winding that operates the tipping solenoid.

The operation is quite obvious. When current is supplied to the transformer the tungars light and when they have reached an operating brilliance they pass sufficient voltage to operate the tipping relay which in turn supplies a.c. to the tipping solenoid. When the solenoid pulls the arc over the pools short, thus shorting the voltage across the relay winding, and the relay contacts open permitting the arc to return to a normal



position and starting the keep-alive arc. If the keep-alive arc should go out, the voltage across the relay winding increases until the relay operates again and the process repeats.

Once adjusted, this system will give no trouble whatsoever. It is well to get a high resistance

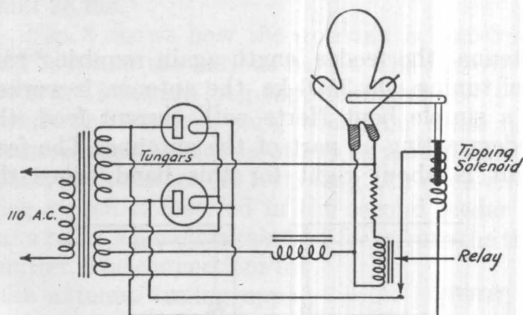


FIG. 9

relay that operates on a current of 0.1 amp. or so in order that a high resistance may be used in series with the winding, thereby reducing the drain on the tungar rectifiers. Long tungar life is secured as the relay does not operate until the tungars have reached an operating temperature.

— J. H. Platz, W9GY

Vacuum Tube Bleeder Resistance

THOSE of the amateur fraternity who lack bleeder resistances of high current capacity should find this kink useful. The idea is to make use of a small resistor of one to four thousand ohms and an old tube suiting that unused filament winding. A grid bias resistance of 2000 ohms does the trick on about 550 volts, using a '26 as the bleeder tube. Fig. 10 is the hookup. It is about the simplest thing imaginable, but I have not seen it mentioned before and I hope it will fill the bill somewhere.

— W. I. Korpi, W9HDN

Revamping the Old Majestic "B" Supply

"B" ELIMINATORS using the familiar Raytheon gaseous type of rectifier are notoriously poor from the standpoint of voltage regulation. However, the regulation of any of these eliminators may be greatly improved and the voltage

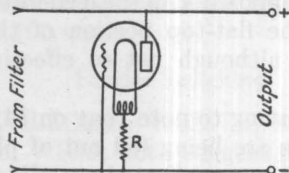


FIG. 10

output materially increased by the simple installation of the now popular 82 mercury vapor tube

in place of the old gaseous tube. In several Majestic "Super-B" eliminators that we have changed over here, the results have more than justified the small amount of trouble it took. After the cut-over, it is possible to work one of these outfits at a load of about 40 mils and still get a voltage in excess of 300 volts.

First, filament supply for the 82 tube must be provided. Any of the numerous small 2½-volt filament transformers handled by QST advertisers will do very nicely. On some of these it is possible to add another 2½-volt winding to handle the receiver heaters and filaments. This will then provide all power supply for a receiver from a single compact unit.

The filament transformer can be mounted down in the eliminator beside the rectifier tube. In some cases, it may be necessary to move the tube socket over to make a little more room for the transformer. It will also be necessary to remove the wiring from the tube socket and change the two high-voltage transformer leads from the filament terminals to the plate and grid terminals respectively. Small r.f. chokes of the mail order variety, costing about 15 cents, should be inserted in each of the rectifier plate leads to reduce or eliminate the mush that is one of the concomitant annoyances experienced with mercury tubes.

It may be that the eliminator condensers will not stand the greatly increased voltage now obtainable. In case they break down, they should be replaced with the square, dry electrolytic condensers that are now obtainable in cardboard

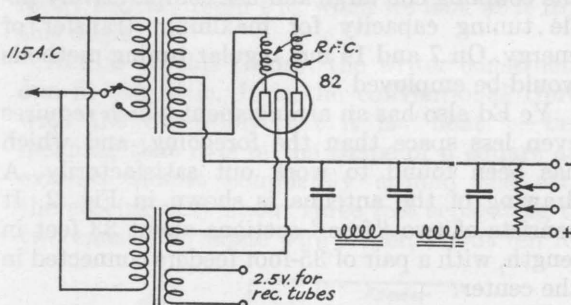


FIG. 11

THE REVAMPED MAJESTIC SUPER B

containers. It would be a good plan to replace the condensers from the start as it is possible to get higher capacity from the electrolytic units and much better filtering and regulation. In four eliminators of this type that I have changed over, two suffered breakdown of the original condensers but now that these have been replaced with the new electrolytic condensers, they are the best of the lot.

— B. P. Hansen, W9JNV

ANTENNA TRICKS

Three-Band Antennas

ALVA PARHAM, W4MR, has a suggestion which should work satisfactorily when it is possible to use fairly long feeders:

"I have noticed several different methods used to adapt one antenna for use on the 14-, 7- and 3.5-mc. bands. Here is my suggestion concerning such antennas.

"Build a 'Zeppelin' antenna with a fundamental in the 7-mc. band with feeders of such length that parallel tuning can be used on 14 and 7 mc. The length of such feeders according to the *Handbook* would be 60 feet. When working on 3.5 mc. the dead-ended feeder could be disconnected and then there would be left a simple voltage-feed antenna about 135 feet long which would be fundamental for 3.5 mc.

"As I am not able to try this antenna myself I would like to hear from anyone who might have an opportunity to use it."

When working on 3500 kc. with this arrangement (shown in Fig. 1), the coupling coil and antenna condenser form a tank tuned to the transmitting frequency. It is advisable, since the antenna is being fed at a voltage loop, to make the coupling coil large and use comparatively little tuning capacity for maximum transfer of energy. On 7 and 14 mc. regular tuning methods would be employed.

Ye Ed also has an arrangement which requires even less space than the foregoing, and which has been found to work out satisfactorily. A drawing of the antenna is shown in Fig. 2. It consists of two "free" sections about 33 feet in length, with a pair of 35-foot feeders connected in the center.

For 14-mc. work there are really two voltage-fed half-wave antennas. The length of the feeders is such that parallel tuning is necessary. On 7000 kc. the system operates as a current-fed half-wave

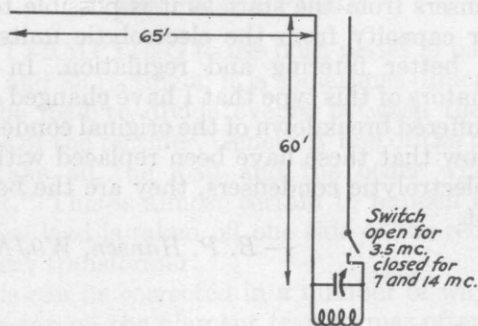


FIG. 1

antenna, the feeder length again requiring parallel tuning. On 3500 kc. the antenna is worked as a simple bent Hertz with current feed, the feeders acting as part of the antenna. The feed point is about right for this band, since the

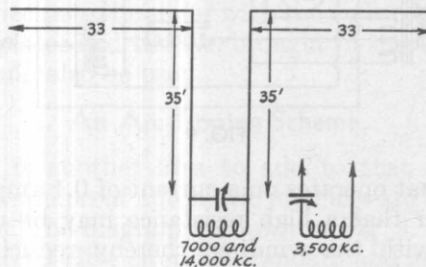


FIG. 2

coupling is near the electrical center of the system. On 3500 kc. the tuning condenser is in series.

While this system is theoretically more efficient on the two higher-frequency bands than on 3500

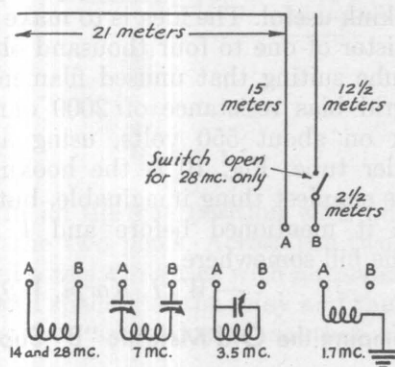


FIG. 3.

kc., actual tests prove that it is a fairly effective radiator on the latter band. The use of only one series condenser throws the currents somewhat out of phase opposition in the feeders so that they, as well as the flat-top portion of the antenna, will radiate, although not so effectively as the latter.

It is interesting to note that on 14,000 kc. the two antennas are being fed out of phase, which results in a directive effect along a line perpendicular to the direction of the antenna

With this system it is possible to feed the antenna in the center (which may be an advantage if the best antenna location is one which puts the shack somewhere near the middle of it) and it is not absolutely essential that both halves be in the same line, especially for 14-mc. operation.

Five-Band Antenna

A FURTHER scheme for working a single antenna on all bands is suggested by Guy H. Grosin, F8RJ, ex-F8WHG. Satisfactory operation is secured on all amateur bands between 1.75 mc. and 28 mc.

Fig. 3 shows how the antenna is constructed and used on the various bands. The flat-top portion is 21 meters long (approximately 68½ feet) while the vertical part, which on some bands acts as a feeder and on others as part of the radiator, is 15 meters (49 feet) long. An open-circuiting switch is inserted in the second feeder wire at a point 2.5 meters (about 8 feet) from the transmitter. The connections for the antenna tuning apparatus on each of the bands are shown in the diagram.

For 28-mc. work the switch is opened, and the 8-foot length of feeder and the opposite 8-foot portion of the continuous feeder act as a pair of quarter-wave Zepp feeders, the remaining portion of the continuous wire being a Hertz antenna 3½ wavelengths long. On 14 mc. the switch is closed, and the antenna again operates as a Zepp, this time full wave with ¾-wave feeders. For 7 mc. work the antenna is the conventional half-wave Zepp with series-tuned feeders electrically equivalent to a quarter wave.

When the antenna is to be used on 3.5 mc. the second feeder is disconnected and the other is directly coupled to a tuned tank circuit which is in turn coupled to the transmitter. In this case the whole length of wire acts as a radiator approximately one-half wave long. For 1.75 mc. the same antenna is used, but is connected to ground through a coupling coil, forming a grounded quarter-wave antenna.

That this arrangement works out well is proved by the work F8RJ has done with it. On 1.75 mc. distances of over 2000 miles have been covered; W stations have been worked on 3.5 mc.; and all continents on both 7 and 14 mc., including some 118 countries altogether. The transmitter input was about 100 watts.

Feeder Switching

CLEM WOLFORD, W8ENH, and Robert A. McConnell, W8FJ, both suggest a switching arrangement which is quite the simplest we have seen. Fig. 4 is the diagram. The switch is a double-pole single-throw affair, the condensers being in series when it is open and in parallel when closed.

Series-Parallel Feeder Switch

HERE is an arrangement (Fig. 5) for those of us who are coupling to push-pull oscillators or ampli-

fiers with two coils and a single tuning condenser, instead of the usual single coil and pair of condensers. It requires a double-throw three-pole switch. In the diagram, with the switch in the lower position the condenser is in series, midway between the two coils, while in the upper position the condenser is across the feeders, the coils being connected in series.

— W3CBM

Indoor Transmitting Antennas

AT some time or other in our lives have we not all had that dream: the "perfect antenna." To the average amateur, the perfect antenna is one of those beautiful 80-foot latticed masts in the backyard, the guy wires liberally broken up with strain insulators, and the antenna gracefully sloping down to the shack window and entering through a large pyrex bowl.

While some of us may be fortunate enough to have structures like this, to the majority it remains but a dream. Some of us may have 30-foot poles on the garage. Very good. But what about the rest of us, whose backyards, if any, are unsuited to antennas of any type? To these unfortunates, this article is dedicated.

What about the indoor antenna? Oh yes, I know at that word "indoor" you will throw up your hands and shake your heads skeptically. But why let that little word scare you? We use indoor receiving antennas, don't we? They work. Then, why not an indoor transmitting antenna? If we can hear high-frequency signals on an indoor antenna, why, in the name of good common sense, can't we transmit them? It sounds perfectly logical, doesn't it, when we look at it from this angle?

Acting on this theory, the writer constructed one in the attic. It is the conventional Hertz, with the exception that it is "bent" — bent meaning that it is in the shape of a square and extends almost completely around the attic, there being only about three feet separating the two ends. The single wire feeder, about ten feet

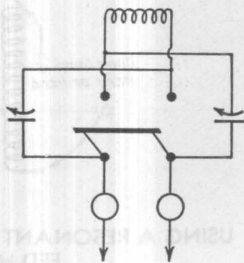


FIG. 4

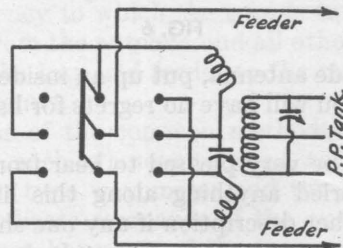


FIG. 5

long, descends directly to the transmitter through the medium of a trap door, which luckily happened to be in exactly the right place. At no point is this antenna higher than 25 feet above the ground. So much for the construction.

Now the next thing, operation. And here is the surprise; it works, and it works equally as well (and I am inclined to think a little better) than

the regular antenna that was being used at the time, which was hung on a 30-foot pole on the top of the house. To you who are blessed with great technical knowledge, this may seem like a mighty broad statement, as it violates many of the hard and fast rules that we have learned about keeping antennas high and as free from all things as possible. Nevertheless, many tests were made with both, and without a single exception the QRK's reported were identically the same. The reports of QRI, however, changed from "near d.c." to "pure d.c. crystal"! The increased stability was due, no doubt, to the fact that, being inside, the antenna is absolutely free from any disturbances.

As to DX, at W8PQ using two Type '10's in parallel and with an input that has never exceeded 100 watts, all continents with the exception of Asia have been worked while using this antenna. Reports of R8 have been received from Europe. Incidentally Detroit has the name of being one of the hardest towns in the country to "get out" of.

The indoor antenna has several advantages over the outdoor type. Mainly, ease of construction; signals steadier with swinging at a minimum; and last but not least, accessibility. This alone means quite a lot when one has to climb up on a slippery roof in the dead of winter to make repairs or adjustments. As to the disadvantages, I have found none. This antenna has been in use at W8PQ exclusively for the last three years.

So, why let that little word "indoor" scare you? If you have not the facilities for the erection

and the roof to see what happened each time something was changed. Lamps of various sorts also were pressed into service to replace the ammeter, obviating the necessity for the field glasses, but still having to be under observation.

The Weston Photronic Cell can be utilized to make the job much easier, if used in a fashion suggested by John Miller, engineer in charge of

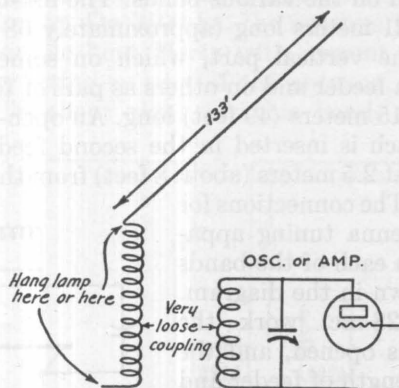


FIG. 7

USING A RESONANT COUPLING COIL WITH THE ENDED HERTZ ANTENNA

the radio division of Weston. A flashlight lamp should be shunted across as much of the antenna as is necessary to make it light with a fair degree of brightness. The lamp is placed in a short tube of bakelite or similar material at the other end of which the Photronic Cell is mounted, as shown in Fig. 6. The tube should be made light-tight, and the whole assembly is hooked to the center of the antenna. A pair of leads (ordinary lamp cord will do) is brought down from the cell to a microammeter or 0-1 milliammeter in the operating room.

With this rig the operator can see instantly the effect on the antenna current of any adjustments he may make. Only d.c. is flowing in the leads from the cell, so any reasonable length may be used. A small-size flashlight bulb (2.2 volts) will cause a deflection of about 150 microamperes on the meter when placed approximately one-half inch from the cell and lighted to normal brilliance.

An Improved System of Voltage Feed

THIS antenna coupling arrangement has been used successfully in my station for several years, and provides a method of feeding the antenna at maximum voltage. A Hertz antenna is used with one end brought into the station, and coupling is effected by a coil of such dimensions that no external capacity is needed. In other words, the coil consists of a half-wave antenna in concentrated form so that it has voltage loops at each end and a voltage node in the middle. One end of this coil is connected directly to the antenna and the other end is left open, as shown in Fig. 7. Because of the relatively large number of turns a very high

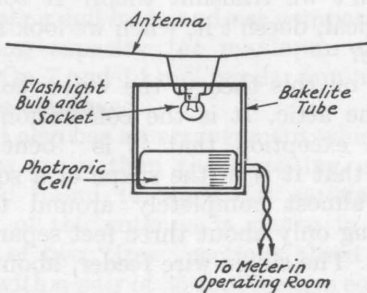


FIG. 6

of an outside antenna, put up an inside one and I feel that you will have no regrets for having done so.

I would be very pleased to hear from any one who has tried anything along this line and to give a further description if any one should be so interested.

— Kelsey Ladue, W8PQ

New Use for the Photronic Cell

WHEN Hertz antennas first came into vogue it used to be quite a problem to get them tuned up properly. One stunt was to put an ammeter in the center of the antenna and keep watch on it with field glasses while someone else made adjustments to the transmitter — or, if it was a one-man job, dash back and forth between the shack

voltage is generated in the coil and the voltage end of a Hertz can be fed in great style.

The antenna used here is 133 feet long and works on the 80-, 40- and 20-meter bands. The coupling coils are of the pancake type. For the 40-meter band I use 21 turns of $\frac{3}{8}$ inch copper

of course) and note where the lamp is brightest. Maximum output will be obtained only with very loose coupling. Once adjusted this method will produce a very stable signal and may clear up that r.a.c. note that has been so persistent on 20 meters.

— E. W. Lincoln, W1BNM

Reducing Harmonic Radiation

WITH increased activity in the new 3900-4000-kc. amateur 'phone band and also the higher frequency portion of the 7000-kc. band, i.e., 7200 to 7300 kc., and because of the fact that the second harmonics of both these frequency ranges fall in frequency assignments other than amateur bands, it is essential that harmonics be reduced to the minimum. While harmonic interference might possibly be tolerated when it falls within another higher frequency amateur band, it actually amounts to illegal operation in somebody else's territory if interference is caused to commercial services. Strong harmonics at high frequencies are likely to cause interference with stations hundreds of miles away because of the effects of skip-distance and the well-known carrying power of the higher frequencies at low transmitter power inputs.

There are several simple ways of eliminating such interference. One system which is very easy to make work and is very effective when using single-wire feeder Hertz is given in the diagram, Fig. 8.

Examination of the circuit will show that it is nothing more than the old familiar wave-trap used for a new purpose. The trap circuit may be used either directly or inductively coupled. Both methods are shown in the drawing.

The operation of this harmonic eliminator is quite simple. Since the feeder is aperiodic, tuning of the trap circuit has little or no effect upon the r.f. voltage traversing it except in the case where the trap is tuned either to the fundamental (first harmonic) frequency or to some higher harmonic of the fundamental frequency. In this instance the frequency to which the trap is tuned will be isolated from the antenna and all others will pass through the trap and feeder to the radiator part of the antenna.

Any one of the common methods of showing resonance, such as a neon tube, r.f. galvanometer, absorption type wavemeter and the like can be used to indicate resonance of the wave-trap circuit to some harmonic of the transmitted wave. One must be sure, however, that the trap is tuned to the harmonic frequency which it is desired to eliminate.

This arrangement can be used very easily to eliminate several objectionable harmonics. If it is found necessary to do this, place as many of the tuned trap circuits in series with the feeder as there are harmonics to be eliminated. Then tune each trap to one of the harmonics so that all have been trapped out.

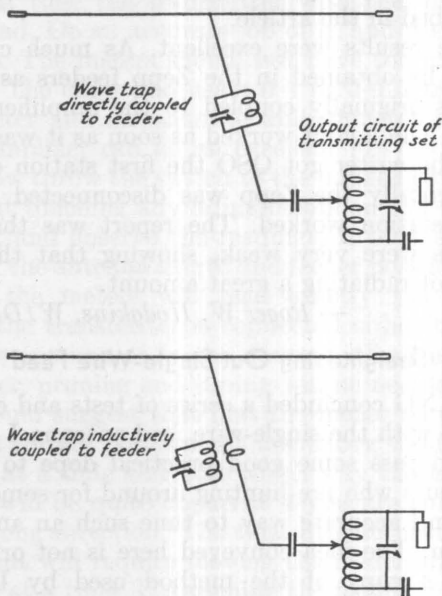


FIG. 8

USE OF WAVE-TRAP TO ELIMINATE HARMONICS

The constants of the trap should be such that it will tune to the frequency of the harmonic which is to be eliminated.

ribbon, each turn spaced about $\frac{1}{8}$ inch. The inside diameter is $2\frac{1}{4}$ inches and the outside diameter 8 inches. For the 20-meter band I use 13 turns spaced $\frac{1}{4}$ inch. An 80-meter coil would be too big for convenience, so I use the 40-meter coil with the voltage node grounded. In reality this makes a quarter-wave coil with voltage on the antenna end and current flowing to the ground. The inside end of the coils should be connected to the antenna. It is convenient to have the oscillator or power amplifier tank inductance of the pancake type also. The coupling between the tank inductance and antenna coil must be very loose or the system will be inoperative. For 40 meters 8 to 10 inches is used and the distance for 20 was so great that I had to hinge the coupling coil at considerably more than 90 degrees.

Now for tuning the system for maximum output. The cut-and-try method is the only way to arrive at the correct values for the coupling coils, but this will not be found very difficult. The essential part is to have an antenna of the correct length. The best resonance indicator was found to be a 5-watt 115-volt lamp such as can be purchased in any Kresge Store. Solder a hook on the center connection and simply hang the lamp on either the open end or the antenna end of the coupling coil. Adjust the frequency of the oscillator or power amplifier (keeping within the band,

Undesirable second harmonics can be minimized by the use of a Marconi type antenna. This type of aerial is not readily adaptable to 7000 kc., but could be used on the 1715- and 3500-kc. bands.

Class C amplifier operation produces generous harmonics, especially when the tank is operated with low C . While the efficiency will be lowered it sometimes may be found desirable to substitute a high- C tank if harmonic troubles become too bothersome. This same thing is true of self-excited oscillators. Just another argument to change over to high C with its better note and less obnoxious harmonics.

With the amateur and commercial ranks increasing every day it is a very important matter to see that out-of-the-band harmonics are eliminated insofar as possible, and it is hoped that these suggestions will be of some assistance to those suffering from such troubles.

— Everett L. Dillard, W9BKO

EDITOR'S NOTE. — A push-pull output stage also is advantageous from the harmonic radiation standpoint because even harmonics are balanced out. Odd harmonics can be radiated, however. In general, with any antenna coupling scheme which utilizes *current feed*, that is, a system in which an antinode of the antenna or feeder current occurs at the antenna coupling coil when the system is tuned to resonance with the transmitter, chances of even harmonic radiation are lessened, particularly if the system is grounded at the antinode. Cases of this type are the grounded Marconi-type antenna mentioned above, and a Zepp feeder in which each feeder is a quarter wavelength long. These systems are often good radiators of odd harmonics, however.

Coupling an Untuned Line to a Zepp

AFTER reading the article on transmission lines in the October, 1932, *QST* the writer decided to place one of the untuned variety in operation. The radiating system is a Zepp antenna designed for the 3500-kc. band, and since there was no diagram in the article which gave a means of feeding a Zepp with a random length transmission line, the method shown in Fig. 9 was tried.

Referring to the drawing, the line was coupled

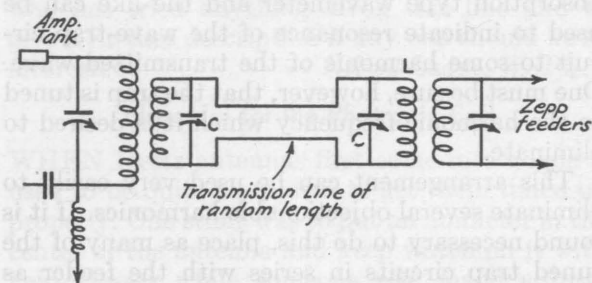


FIG. 9

COUPLING AN UNTUNED TRANSMISSION LINE TO A ZEPP ANTENNA

to the amplifier tank by a coil and condenser, L and C . This coil and condenser was constructed to tune to resonance with the amplifier tank frequency. At the receiving end of the transmission line a duplicate of L and C was placed. The Zepp was then coupled to the receiving end in the conventional way. The line was tuned exactly as described in the article.

The results were excellent. As much current could be obtained in the Zepp feeders as when it was originally coupled to the amplifier tank itself. The layout worked as soon as it was built and the writer got QSO the first station called. Incidentally the Zepp was disconnected and a local station worked. The report was that the signals were very weak, showing that the line was not radiating a great amount.

— Roger W. Hodgkins, W1DUW

Straightening Out Single-Wire Feed

HAVING concluded a series of tests and experiments with the single-wire feed antenna I would like to pass some good practical dope to other amateurs who are hunting around for some definite and accurate way to tune such an antenna system. The idea conveyed here is not original, being a copy of the method used by United Airlines engineers in tuning their antenna systems.

The figures in the *Handbook* show that the feeder is attached at a point on the flat-top distant from the center by a length equal to 14% of the entire length of the flat-top portion. The length of the feeder is of course optional. With such an arrangement, the feeder will have a characteristic impedance of 500 ohms.

Now if the transmitter is tuned to a frequency which resonates exactly with the flat-top radiating portion of the antenna, and if the feeder is attached at the correct point, the r.f. current in the feeder and the plate current drawn by the final amplifier will exactly match the readings when the transmitter operates into a dummy antenna consisting of 500 ohms of non-inductive resistance. Such a dummy may be rigged up of carbon lamps — not Mazda or tungsten, which have some inductance — the size of the lamps being determined by the amount of power output. Here at W6AEW, I am putting out .5 ampere r.f. into the feeder, and use four 120-volt 120-watt lamps in series. Such a dummy is good from .4 to 1.5 amps. r.f. and will serve everything from medium power up to and a little over 1 kw. output. Between these two figures, this dummy has a pure resistance of 500 ohms. Parenthetically, before one starts pruning and tuning the antenna system the feeder should be arranged to run at right angles to the flat-top portion at least one-quarter of its entire length. Sharp bends in the feeder should also be avoided.

To make rapid comparisons of currents with the dummy antenna and feeder, a single-pole

double-throw switch should be connected in so that the transmitter can be switched quickly from one to the other. Connect the switch blade to the tap on the transmitter tank coil; one jaw goes to the dummy, the other end of which comes back to the low-potential end of the tank; the other jaw goes to the feeder.

First, tune the transmitter with the dummy as a load. Do an accurate job of it, and use your meters. The meters should not have too great a range. The chap who has a 0-1 or 0-1.5 ampere r.f. meter and an accurate milliammeter in the final amplifier can do an excellent job of tuning up. Now throw the switch to the outside antenna without touching any adjustments on the transmitter, and observe the readings. If by a stroke of luck the antenna length and feeder position are right, the meters will read exactly the same when the transmitter is connected either to the outside antenna or to the dummy. Chances are, however, pruning and tuning will be necessary.

I would suggest that first the feeder be tuned for the correct position. At first move the feeder a foot at a time and note which way the meters go. It will be quite apparent if you are going in the wrong direction. The final and accurate adjustment will require moving the feeder an inch or two at a time. If attaching the feeder at various points within reasonable distance of the 14% point does not bring about a match, it is an indication that the frequency of the transmitter does not resonate with the flat-top portion of the antenna. If crystal control is used, pruning the antenna is in order. Cut off or add on about two feet at first. Then go through the process of moving the feeder around. If you added antenna where it should have been shortened, it will show up because in sliding the feeder around the match will be further off than before. Cut off the length added, plus a couple feet more. Now tuning the feeder will bring closer results. Keep this up until the absolute match is found. If a self-excited oscillator is used and frequency can be shifted at the transmitter, no pruning or adding will be necessary unless the antenna tunes out of the band, or one desires to work at some particular spot. Merely shift the frequency at the transmitter and watch the feeder current. The feeder current can be matched by this method, but if the feeder is attached at the wrong point, the plate current will differ from the reading shown when on the dummy. As the correct point is approached, the plate current will come nearer the match. And so, back and forth, until the objective is reached—a perfect match on dummy and outside antennas.

As for results, I can safely say that time spent getting this antenna system tuned up properly is worth while, as it certainly increased my DX per dollar. Also, I_2R will give you the power output, from which the efficiency can be computed. And that will show up many things which may

lead to further studies to increase the watts per dollar.

— J. H. Gurr, W6AEW-W6ZZCD

Slotted Feeder Separators

FIG. 10 shows a neat method of fastening Zepp feeders to spacers, suggested by Robert E. Foltz, W9GKG. It has the advantages of neat appearance and ease of construction, and permits slipping the spacers along the feeder wires to get them in just the right position.

A slot $\frac{3}{4}$ -inch deep and wide enough to take the feeder wire is sawed in each end of the spacer and a hole drilled through at right-angles to the slot about a half-inch in from the end. A machine screw is run through the hole and fastened down with a nut. The wire slips in the slot outside the bolt near the end of the spacer, and when the latter is in the right position the bolt is tightened to hold the wire securely in place. The gripping pressure is greatest near the ends of the spacer. The spacers should be made of hard wood boiled in paraffin.

Keeping Feeders Taut

FIG. 11 illustrates the method used by T. S. Shaw, W6AVN, for pulling Zepp feeders tight without putting any strain on the antenna proper.

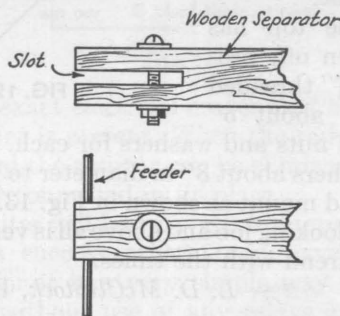


FIG. 10

With taut feeders there is no necessity for a large number of spacers, and the frequency change caused by swinging feeders is largely eliminated.

Another Suggestion

WHEN Zepp feeders are pulled off at an angle from the antenna one wire usually is tight as a drum and the other hangs slack unless the separators are put on at just the right angle—which is not a right angle. A Memphis ham suggests the arrangement shown in Fig. 12 to overcome this. All the pull is concentrated on one point, and the actual connection of the live feeder to the antenna is made by a short piece of flexible wire.

Inexpensive Lead-in Insulator

I HAVE seen various ideas as to different forms of lead-in insulators using pyrex custard cups, baking dishes, etc. Several months ago while installing my station I struck the idea of using percolator tops. They can be purchased two for five cents, and if a few are broken one is not

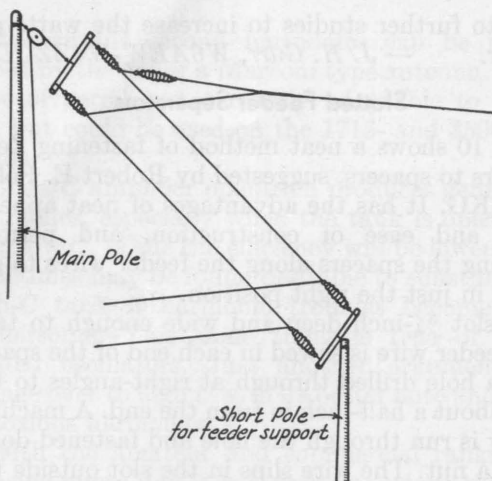


FIG. 11

out much. To break off the knob on top tie wool yarn or string just below the knob. Saturate it in kerosene, light and allow to burn as long as it will, then plunge in cold water. This will make a clean break which can be ground down smooth on an emery wheel. If a person has access to a power grinder the top can be ground off if care is taken not to get the glass too hot.

After the top has been broken off, procure two $\frac{1}{4}$ " threaded brass rods about 5" long with 4 nuts and washers for each. Cut some rubber washers about 3" in diameter to put under the tops and mount as shown in Fig. 13. It makes a very nice looking job and above all is very reasonable — in trend with the times.

— L. D. McClintock, W9GUS

The Short Receiving Antenna

IN SEARCHING for a means of cutting down the signal-to-noise ratio in an amateur receiver, I have been experimenting with the circuit shown in Fig. 14.

We all know that the shorter the receiving antenna the better the signal-static ratio, but the use of a very short antenna means a loss in signal strength. I connect an antenna, cut to the length which gives the proper amount of grid damping, directly to the grid of a tube used in a plain regenerative detector circuit. With this arrangement, the signal strength is practically the same as when a long antenna is used in the ordinary manner. For some types of static the ratio is quite noticeably improved, while for other types the improvement is only slight.

If a regenerative detector designed for use with the ordinary antenna is tried, it will be necessary to rebuild the tuning coil for this method of grid loading. To date I have not had much success in applying this principal to tuned radio frequency amplifiers, which as in the case of the

regenerative detector must have a redesigned tuning coil.

The house lighting system and the transmitting antenna system interact with the short antenna, so it is best to keep it as far away from both as possible.

— Howard F. Barkley, W1ADF

Eliminating Background Noise

HERE is a receiving antenna that actually works wonders in cutting down QRM. It was devised to operate with the short-wave receiver in the operating room of KFPY, and certainly does its stuff. The operating room is built above the elevator penthouse on top of a four-story building in the heart of the business district of Spokane. In the elevator room are many large relays that clatter continuously and draw large sparks and arcs, making (as one might imagine) plenty of noise. Using the usual type antenna with the receiver about ten feet above these relays, reception of anything is impossible because of the high noise level. The receiver is a three-tube job using tuned r.f., detector and one audio, all of the 2-volt type.

Our first attempt was to use a conventional antenna with a shielded lead-in, but helped very little — if any. The final result is pictured in Fig. 15. The two-wire duplex lead is obtainable in most places and is not so very expensive. Its use will warrant the cost, I am sure.

I may also add that not a sign of KFPY (1000 watts) is heard even with the receiver 5 feet from the high power inductance. It's some trick to hear DX when only 5 feet from such a transmitter, 10 feet above elevator relays, and in the heart of the business district; but it can and is being done. Each of the coils marked *L* has 5 turns. The two at the antenna end are closely coupled by jumble-winding them together.

— Wes Bell, W7ADU

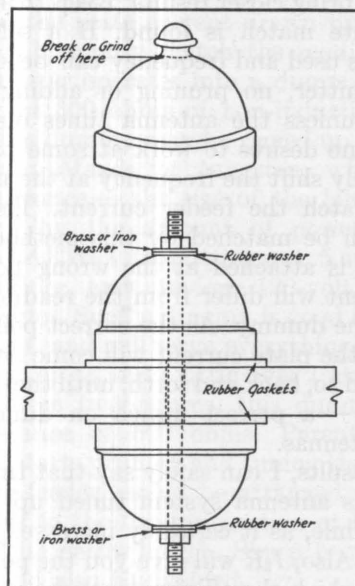


FIG. 13

Using the Transmitting Antenna for Receiving

PROBABLY many amateurs are so situated that they are cramped for antenna space; that is, they will find room for their transmitting antennas and then not have a desirable location left for the receiving antenna. To such amateurs it prob-

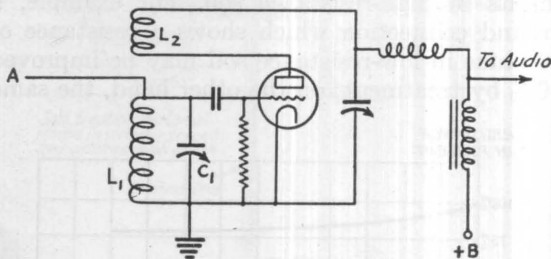


FIG. 14

SHORT ANTENNA FOR GRID DAMPING AS USED BY W1ADF

For the 3500-kc. band the antenna, A, is approximately seven feet long. Other lengths will be required for the other bands. C₁ is a 5-plate midget, L₁ has 20 turns on a tube base and L₂ 15 turns on the same tube base. These approximate specifications are for 3500 kc.; the exact number of turns must be determined experimentally for this and other bands.

ably will be welcome news to know that they can satisfactorily use the transmitting antenna for reception and be able to work break-in at the same time.

The writer has a transmitting antenna 132 feet long and no room for running a receiving antenna except parallel to the transmitting antenna. Shorter receiving antennas were tried and run in different directions around the house but, due to their shortness, gave very poor results and also did not permit satisfactory break-in operation.

Many different schemes were tried to utilize the transmitting antenna for reception without results. Finally the scheme was tried of attaching the short-wave receiver antenna connection to the exact electrical center of the antenna coupling coil. When this exact electrical center was found and the receiver connected to it, it was possible to obtain all the benefits of a long antenna for reception and at the same time have no interference whatsoever from the transmitter when working break-in. It was found desirable to connect a small condenser in series, as shown in Fig. 16.

The above scheme has now been in use for some time and has been found to give very satisfactory

results. No reduction of feeder current is noticeable, and when using this scheme it is impossible to detect any difference in the note of the emitted wave when checked on a monitor.

As the electrical center to which the receiver is connected is at a point of zero voltage, this explains why no interference is noticeable when working break-in. There is actually less transmitter interference when using this scheme than when a short 20-foot wire at right angles to the transmitting antenna is used.

The best method to find the electrical center is to run a wire from the receiver with a clip attached and approximately 2000 ohms in series. Then with the transmitter key depressed touch the clip to different parts of the coupling coil until the point is found where the least interference is noticed on the receiver. It will be found that if this wire is touched even a few inches away

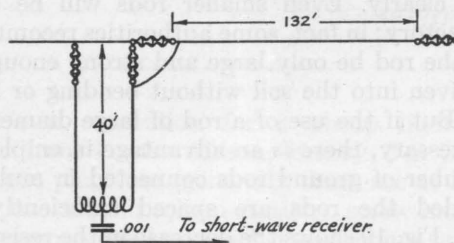


FIG. 16

from the exact electrical center that considerable interference is present. When the right point has been found the resistor can be eliminated and the condenser connected in its place.

The writer will be very much interested to find out what success others may have with this scheme, for it is a very simple way of working break-in without use of any relays and without the use of an additional receiving antenna.

— W. P. Koehel, W9BNE

Grounds

ALTHOUGH the ground connection is not given nearly as much attention in these days of Hertz antennas as it was when spark transmitters were in vogue, the increasing use of the 1750-kc. band again brings up the question of the "good" ground, because not all of us have room to put up Hertz antennas for that band and therefore are forced to use a Marconi-type antenna. The following information extracted from a bulletin published by the Copperweld Steel Company should prove to be useful in such cases, particularly if there is any reason to suspect that the w.k. water-pipe is not working out so well.

There are four principal factors affecting the resistance of a ground connection. These are the length of the ground rod, the diameter of the rod, number of rods used, and the character of the soil. Taking the rod itself first, its length should be such that it will reach below the permanent moisture level of the soil. Of course the depth of

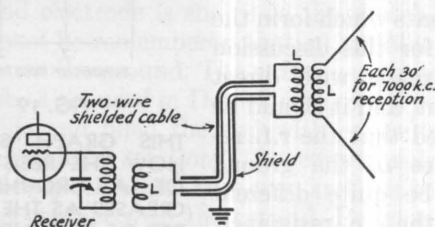


FIG. 15

the moisture level will vary with different localities, but experience indicates that to fulfill this requirement the rod should be at least 8 feet long. Fig. 17 is a curve, taken from Bureau of Standards Technical Paper No. 108, showing the calculated effect of the length of the ground rod on the resistance of the ground connection for one type of soil. In practice it is likely that a greater decrease in resistance than the curve indicates will be obtained at the lower depths, because there is usually more permanent moisture at the lower depths than near the surface. A deep ground is also likely to maintain a more constant resistance under all sorts of weather conditions for the same reason.

Rather surprisingly, the diameter of the ground rod has comparatively little effect on the resistance. There is little advantage in using a rod of greater diameter than one inch, as Fig. 18 shows quite clearly. Even smaller rods will be quite satisfactory; in fact, some authorities recommend that the rod be only large and strong enough to be driven into the soil without bending or splitting. But if the use of a rod of large diameter is unnecessary, there is an advantage in employing a number of ground rods connected in multiple, provided the rods are spaced sufficiently far apart. Fig. 19 shows the decrease in the resistance of the ground connection with an increasing number of rods with three different separations. Taking the resistance of the ground connection as being 100% with a single rod, it is evident that 2 rods separated by 4 feet will show only 65% as much resistance, while with 4 rods and the same separation the resistance will be down to about 37%. The benefits to be obtained by using a number of rods are markedly less if the separation is smaller than 4 feet, while the decrease in resist-

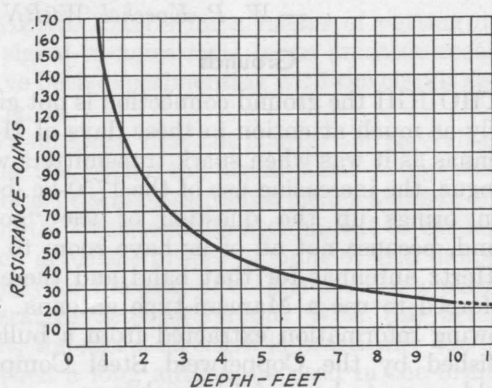


FIG. 17

CALCULATED EFFECT OF DEPTH ON THE RESISTANCE OF A GROUND CONNECTION

ance is slow beyond that separation. We may therefore conclude that rods in multiple should be not less than 4 feet apart and that a greater separation is slightly more desirable.

The effect of the soil on the ground resistance depends upon the type of soil and cannot very

well be predicted. The resistance of the connection can be measured if suitable instruments are available, but few amateurs are so equipped. Naturally-moist soil probably has the least resistance. The resistance of any ground connection can be reduced by soil treatment, although treatment usually gives comparatively better results in high-resistance soil. For example, a ground connection which shows a resistance of 30 ohms in low-resistance soil may be improved 50% by treatment; on the other hand, the same

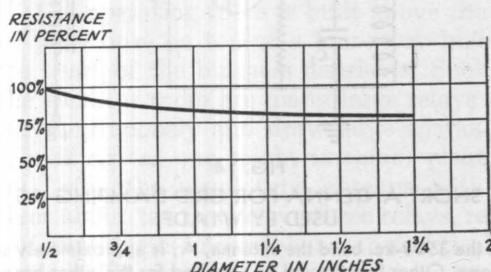


FIG. 18

EFFECT OF DIAMETER OF DRIVEN GROUND ROD ON GROUND RESISTANCE

treatment may reduce a resistance of the order of 1000 ohms by 90%.

Fig. 20 shows the method which has proved to be most effective in treating soil to reduce resistance. A shallow trench is dug around the ground rod about 18 inches from it and the treating material poured in, after which the trench is covered with earth. The chemicals used chiefly are magnesium sulphate, common rock salt and copper sulphate. The salt crystals should be placed in the trench—the salt should not be dissolved in water before being used—after which the trench may be flooded with water. Normal rainfall will furnish enough water for carrying the crystals in solution into the earth. The solution seeps downward through the soil around the electrode, thus taking the most effective position for reducing the resistance. Fifty pounds of crystals placed at the top of the soil in this fashion will have an effective life of two to three years for the first treatment. Subsequent treatments show longer life than this.

The resistance measurements which form the basis for this discussion were made with direct current, and it should be realized that the r.f. resistance of the ground may be quite different from the d.c. resistance. It seems logical to sup-

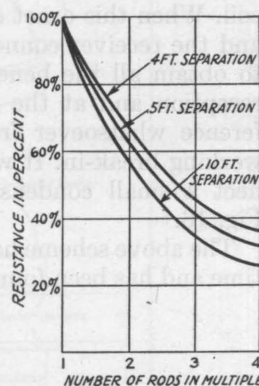


FIG. 19

THIS GRAPH SHOWS HOW THE RESISTANCE OF A GROUND DECREASES AS THE NUMBER OF GROUND RODS IS INCREASED

pose, however, that the benefits obtained by these methods would be applicable to radio frequency.

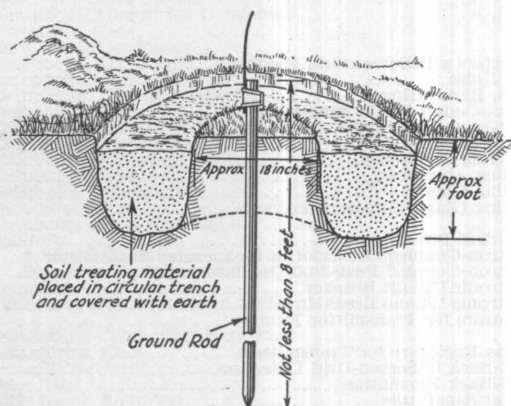


FIG. 20

TRENCH METHOD OF SOIL TREATMENT

Probably the most effective scheme of utilizing chemicals to lower soil resistance.

Curing Noisy Ground

MANY amateurs use no ground connection, so they will not be very much interested in this story at the present time. However, it may come in handy at some future date when a ground is needed.

Here at OA4AB it was found that better reception was obtained using a ground, but from time to time terrible crackling noises were heard when they were least needed. The operator, being interested in geophysics, thought that perhaps

the noises were caused by galvanic action between the iron rod and the ground. The difference in potential between two such rods often is very great, sometimes being over 1000 millivolts. Theoretically almost any electrical or magnetic disturbance in the earth will change the potential about these iron electrodes. This can be remedied by using non-polarizing electrodes, which

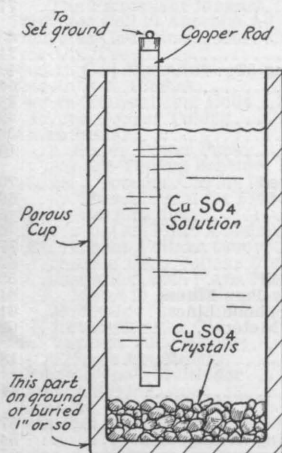


FIG. 21

sounds expensive, but such electrodes can be built cheaply and rapidly.

A good electrode is shown in the sketch, Fig. 21. It must be remembered that no metallic part must touch the ground. The writer used a porous cup such as are used in Daniell cells, put a copper rod inside and filled the cup with concentrated copper sulphate solution. The copper sulphate seeps slowly through the cup and makes an excellent contact with the ground. Resistance of the electrode ordinarily is about 500 ohms, but

depends on the moisture content of the ground. This electrode sets up practically no galvanic action and the problem of a drifting potential about the ground electrode is solved. This rig did the work at OA4AB. There may be a few others bothered by crackling noises in their sets who may find this to be a solution to their troubles.

— Walter Butz, OA4AB

The glass toothbrush holders which serve so well as spacers for feeder wires may also be used as stand-off insulators if the strain is not great. Simply drive two or three long-shank tacks through the perforations in one of the end pieces; this will hold the end piece firmly to the wall and the glass can then be threaded into it. After that it is simple to attach the lead-in or feeder wire to the other metal end piece.

— W8BRD

Here's a suggestion for a cheap lightning arrester from Lamar Allison, Emory, Va. Get a blown-out plug fuse (generally there are at least one or two around a ham station), screw into an ordinary porcelain lamp socket and mount on the window sill. Connect antenna and ground as with any other arrester. The gap in the fuse preferably should not be too great — a 64th of an inch will be about right — so pick out one that has been blown gently (!!).

W9IN finds that rubber nipples (swiped from the junior op's bottle) make good rain protectors for porcelain tube lead-in insulators. The bottle end of the nipple is slipped over the tube and the antenna wire goes through the hole that's intended to pass the milk.

When using Pyrex bowls as lead-in insulators a threaded rod twelve inches or more in length is necessary to connect the two. If the threaded rod cannot be obtained a piece of copper tubing may be substituted by sinking a 5/32 brass bolt in each end of the tubing and soldering them in place. The heads of the bolts must be removed first, of course.

— W8BR-DXJ

W9DPE uses a pair of No. 10 weather-proofed wires twisted together as Zepp feeders. The wires are cut to the same length as ordinary spaced feeders and tune just as sharply. The whole system is much lighter than when spacers are used, and frequency change with swinging in a strong wind is eliminated.

INDEX

	PAGE		PAGE
Accurate Calibration of a Receiver	15	Detectors with Screen Grid Feedback	13
Adapter for the SE-143	14	Dial Noise	18
Aluminum, Cleaning Holes	9	Dials, Renovating	9
Aluminum, Cutting Holes	3	Direct-Coupled R.F. Amplifiers	26
Aluminum, Cutting Sheet	3	Doubler and Oscillator, Combined	25
Aluminum Pan for Chassis	18	Doubler, "Power Type"	24
Aluminum Panel Finish	9	Doubling Frequency	21
Amplifier Coupling	22	Drilling Aluminum	9
Amplifier Link Coupling	28	Drilling Glass	3, 4
Amplifier Protection	65	Drilling Glass, Lubricant Formula	9
Amplifiers, Direct Coupled R.F.	26		
Antennas:		Electrical Interference	62
An Improved System of Voltage Feed	70	Electron-Coupled Oscillator in Inexpensive Transmitter	28
Coupling an Untuned Line to a Zepp	72	Electron-Coupled Push-Pull Oscillators	22
Curing Noisy Ground	77	Electronic Circuit Breaker	66
Eliminating Background Noise	74	Electronic "Phone Break-In"	47
Feeder Spacers	77	Enclosure for Transmitter Frames	33
Feeder Switching	69		
Five-Band Antenna	69	Frame Enclosure for Transmitters	33
Grounds	75	Feed-Back in Screen-Grid Detectors	13
Indoor Transmitting Antennas	69	Feed-Back Prevention	48
Inexpensive Lead-In Insulator	73	Feeder Separators	73, 77
Keeping Feeders Taut	73	Feeder, Single Wire	72
Lead-In Insulators	77	Feeder Switching	69
Lightning Arrestor	77	Feeders, Keeping Taut	73
New Use for the Photronic Cell	70	Filament Blinking Cure	34
Reducing Harmonic Radiation	71	Filament Voltage Compensation	64
Series-Parallel Feeder Switch	69	Filter Condensers, Repairing Blown-Out	65
Slotted Feeder Separators	73	Filtering, Improved	65
Straightening Out Single-Wire Feed	72	Finish for Aluminum Panels	9
The Short Receiving Antenna	74	Five-Bank Antenna	69
Three-Band Antennas	68	Five-Prong Coil Form R.F. Transformer	10
Using the Transmitting Antenna for Receiving	75	Flashlight Lamp Test Loop	30
Anti-Yooping Devices	52	Frequency Doubling	21
Arc-Tipping Scheme	66	Frequency Meters:	
Arrestor, Lightning	77	Calibration Curve Paper	51
Audio Amplifier, 57 as High Gain	42	Checking the Frequency Meter from WWV Signals	50
Audio Selectivity, Tone Control	16	Circular on WWV Transmissions	51
Automatic Break-In for "Phone"	45	Minimizing Frequency Drift	50
		The B.C. Superhet for Calibrating	49
B.C. Superhets for Calibration	49	Frequency of Crystal, Measuring	34
Background Noise Elimination	24	Full-Wave Operation of Mercury Vapor Rectifiers with	
Band-Spread, Simplified	10	Plates in Parallel	66
Bias Problem Simplified	19	Fuses from Condenser Foil	34
Bleeder Resistance, Vacuum-Tube	67		
Blocked-Grid Keying Arrangements	54, 55	Gas, Freeing Tubes of	34
Blocked-Grid Keying Simplified	52	Gaseous R.F. Indicators	34
Blocking Voltage, Simplified Method of Obtaining	54	Gaseous Rectifier "B" Supply Revamped	67
Blown-Out Filter Condensers	65	Glass Drilling	3, 4
Break-In, Systems for "Phone"	45-48	Glass Drilling, Lubricant Formula	9
Break-In with Crystal Control	58	Grid Modulation	30, 31
Bug, Vacuum-Tube	57	Grounds	75
By-Passing Pointers	23	Grounds, Curling Noisy	77
Calibration Curve Paper	51	Handy Power Pack	63
Calibration from B.C. Superhet	49	Harmonic Radiation, Reducing	71
Calibration Method	51	High Gain Audio Amplifier Using 57	42
Calibration of a Receiver	15	High Voltage from '80's	64
Cap, Fixing Tube	9	Hissless Carbon Microphone	40
Caps for Screen-Grid Tubes	18	Holes, Cutting in Aluminum	3
Carbon Microphone, Hissless	40	Holes, Punch for Socket	6
Chassis, Aluminum Pan	18	Hum, Cutting Out Tunable	10
Checking Frequency Meter from WWV Signals	50		
Chokes, Plug-In R.F.	5	Improved System of Voltage Feed	70
Chokes, R.F., From Coils	34	Indoor Transmitting Antennas	69
Chokes, R.F., Winding Form	34	Inductance Clip	5
Chokes, R.F., Winding Machine	7	Insulator, Stand-Off	6
Circuit Breaker, Electronic	66	Insulators, Lead-In	73, 77
Class B Modulator	45	Interference, Electrical	62
Cleaner	18	Interference, Elimination of Local	59
Click Preventer	53	Interference Elimination by Low-Pass Filters	61
Clickless Keying	55	Interference Elimination in Telephone Lines	61
Clip, Inductance	5	Interference with B.C.L.'s on 5 Meters	62
Coil Form, 5-Prong, R.F. Transformer	10		
Coil Mounting	5	Jack, Mounting	18
Coils, Plug-In Transmitting	19		
Condenser, Homemade Neutralizing	19	Key, Auxiliary in 110-volt Line	34
Condenser Microphone	37	Keying:	
Condenser Microphone Circuit	40	A.V.T. Bug	57
Condenser, Sparking Cure	34	Another Blocked-Grid Keying Arrangement	54
Condensers, Split-Stator Midget	17	Another Keying Scheme	55
Control, R.F., on SW3	11	Anti-Yooping Devices	52
Converter Hints	12	Clickless Keying	53
Converter, Single Tube	14	Key-Click Preventer	53
Converter for Ultra High Frequencies	17	More About Keyer Tubes	57
Copper Tubing, Polishing	9	Operating the Keying Relay from the Plate Supply	53
Copper Tubing, Softening	9	Primary Keying	55
Coupling, Amplifier	22	Simple Method of Obtaining Blocking Voltage	54
Coupling Link	28	Simplified Blocked-Grid Keying	52
Coupling Untuned Line to Zepp	72	Simplified Tube Keying	56
Crystal Control, Easy QSY	33		
Crystal Holder, Adjustable	33	Lag Circuit	27
Crystal, Measuring Frequency	34	Lamp, Test	28
Crystal Oven	31	Lead-In Insulators	73, 77
Crystal Oven Thermometer	32	Level Indicator	42
Crystals, Cutting	9	Lightning Arrestor	77
Curling Parallax	16	Link Coupling	28
Cutting Holes in Aluminum	3	Local QRM, Running Down	59
Cutting Sheet Aluminum	3	Low-Pass Filters to Eliminate Interference	61
D.C. Field Velocity Microphone	35	M.O.P.A. Bias Problem	19
Detector, Screen Grid, Type '38	12	M.O.P.A. Protection	65
Detector Sensitivity and Screen Grid Voltage	13	M.O.P.A. Transmitter	30
Detector, Two Tube	11	M.O.P.A. Transmitter Using Receiving Tubes	20

	PAGE		PAGE
Majestic "B" Supply Revamped.....	67	Cutting Out Tunable Hums.....	10
Markings, to Restore on Dials.....	9	Detectors with Screen-Grid Feed-Back.....	13
Mercury Vapor Rectifiers with Plates in Parallel.....	66	Dial Noise.....	18
Meter Shunt.....	5	Mounting 'Phone Jack.....	18
Meter, Switching the Plate.....	33	R.F. Control on the SW3.....	11
Microphone, Circuit for Condenser.....	40	R.F. Transformer With 5-Prong Coil Forms.....	10
Microphone Case.....	48	Screen-Grid Tube Caps.....	18
Microphone, Condenser.....	37	Screen-Grid Voltage and Detector Sensitivity.....	13
Microphone, D.C. Field Velocity.....	35	Simplifying Band-Spread.....	10
Microphone Feedback Prevention.....	48	Some Converter Hints.....	12
Microphone, Hissless Carbon.....	40	Split-Stator Midget.....	17
Microphone, Permanent Magnet Velocity.....	36	The Two-Tube Detector.....	11
Milliammeter, Multi-Range.....	6	The Type '38 as a Screen-Grid Detector.....	12
Milliammeter, Using Voltmeter as.....	7	Regulation, Power Supply.....	63
Minimizing Frequency Drift.....	50	Relay from a Buzzer.....	57
Modulation, Grid.....	30, 31	Relay, Operating from Plate Supply.....	53
Modulation Indicator.....	42	Relay Racks.....	8
Modulation Stunt.....	44	Remote Control Systems.....	58, 59
Modulator, Novel Class B.....	45	Reverberation, Cure.....	44
Monitors:		Screen-Grid Caps.....	18
A Simple Monitor.....	49	Screen-Grid Detector, Type '38.....	12
Switching the Monitor.....	49	Screen-Grid Feed-Back in Detectors.....	13
Mounting, Coll.....	5	Screen-Grid Voltage and Detector Sensitivity.....	13
Multi-Range Voltmeter and Milliammeter.....	6	SE-143 Adapter.....	14
Neutralizing Condenser, Homemade.....	19	Sensitivity, Detector, Screen-Grid Voltage.....	13
Neutralizing Kink.....	25	Series Feed Transmitters.....	20
Neutralizing Stunt.....	29	Series-Parallel Feeder Switch.....	69
Noise, Dial.....	18	Sheet Aluminum, Cutting.....	3
Noise Level, Reducing.....	17	Shunt, for Meters.....	5
Noisy Grounds, Curing.....	77	Simple Monitor.....	49
Oscillator and Doubler, Combined.....	24	Single Wire Feed.....	72
Oscillator, Electron-Coupled, in Inexpensive Transmitter.....	28	Slotted Feeder Separators.....	73
Oscillators, Push-Pull Electron-Coupled.....	22	Socket-Hole Punch.....	6
Overmodulation Indicator.....	44	Softening Copper Tubing.....	9
Panel Finish, Aluminum.....	9	Spaced-Turn Chokes, Winding Machine.....	7
Parallax, Curing.....	15	Sparkling Cure, Variable Condensers.....	34
Permanent Magnet Velocity Microphone.....	36	Speech Amplifier, '47 as.....	41
'Phone Jack, Mounting.....	18	Split-Stator Midget Condensers.....	16
'Phone:		Stand-Off Insulator.....	6
A Cheap Level Indicator.....	42	Superheterodyne Converter for Ultra High Frequencies.....	17
A D.C. Field Type Velocity Microphone.....	35	Superheterodyne Converter Hints.....	12
A Hissless Microphone.....	40	Superheterodyne Converter, Single Tube.....	14
A Novel Class B Modulator.....	45	SW3, R.F. Control.....	11
An Inexpensive Way to Operate a Condenser Mike.....	40	Switch, Time-Delay.....	26
An Interesting Stunt for 'Phone Stations.....	42	Switching the Monitor.....	49
An Overmodulation Indicator.....	44	Telephone Line Interference, Curing.....	61
Another 'Phone Break-In System.....	48	Temperature Control Box.....	31
Automatic Break-In for 'Phones.....	45	Temperature Control Box Thermometer.....	32
Curing Reverberation.....	44	Temperature Control with Photronic Cell.....	32
Electronic 'Phone Break-In.....	47	Text Lamp.....	30
Feedback Prevention.....	12	Thermometer.....	32
How to Make a Condenser Microphone.....	37	Thermostat Vacuum-Tube Relay.....	32
Microphone Case.....	48	Three-Band Antennas.....	68
More on 'Phone Break-In.....	46	Three-Band Transmitter.....	34
The '47 as a Speech Amplifier.....	41	Time-Delay Method.....	24
The '57 as a High Gain Audio Amplifier.....	42	Time-Delay Switch.....	26
The Break-In System at W6GM.....	46	Time-Lag Device.....	27
The Permanent Magnet Type.....	36	Tone Control.....	16
Photronic Cell in Antenna Adjustment.....	70	Transformer, R.F., 5-Prong Coil Forms.....	10
Photronic Cell Temperature Control.....	32	Transformer, Testing Windings.....	9
Pick-Up, Tuned.....	22	Transmitters:	
Plug-In Coll Mounting.....	5	A Bias Problem Simplified.....	19
Plug-In R.F. Chokes.....	5	A Handy Test Lamp.....	30
Plug-In Transmitting Coils.....	19	A Home-Made Neutralizing Condenser.....	19
Polishing Copper Tubing.....	9	A Neutralizing Kink.....	25
Power Supply:		A Novel Thermometer.....	32
A Handy Power Pack.....	63	A Pinch-Hitting Neutralizing Stunt.....	29
An Arc-Tipping Scheme.....	66	A Simple Time-Lag Device.....	27
An Electronic Circuit Breaker.....	66	A Three-Band Transmitter with the "Power-Type" Multiplier.....	24
Another Method for Putting '80's to Work.....	64	A Transmitter with Unusual Features.....	30
Better Filtering.....	65	A Tuned Pick-Up.....	22
Blown-Out Filter Condensers.....	65	Adjustable Crystal Holder.....	33
Filament Voltage Compensation.....	64	Amplifier Coupling.....	22
Getting High Voltage from the '80.....	64	An Inexpensive Time-Delay Switch.....	26
Operating Full-Wave Mercury Vapor Rectifiers with Plates in Parallel.....	66	An Inexpensive Transmitter with Electron-Coupled Oscillator.....	28
Protecting the Amplifier.....	65	An M.O.P.A. Transmitter Using Receiving Tubes.....	20
Revamping the Old Majestic "B" Supply.....	67	Auxiliary Key in 110-volt Line.....	34
Vacuum Tube Bleeder Resistance.....	67	Combined Oscillator and Doubler.....	25
Voltage Regulation.....	63	Curing Variable Condenser Sparking.....	34
"Power-Type" Multiplier.....	24	Direct-Coupled Amplifiers in the Transmitter.....	26
Primary Keying.....	55	Easy QSY with Crystal Control.....	33
Punch for Socket Holes.....	6	Freeing Tubes of Gas.....	34
Push-Pull Electron-Coupled Oscillators.....	22	Frequency Doubling.....	21
QRM, Local, Running Down.....	59	Fuses from Condenser Foil.....	34
QSY with Crystal Control.....	33	Home-Made Temperature Control Box.....	31
R.F. Chokes from Coils.....	34	Link Coupling.....	28
R.F. Chokes, Plug-In.....	5	Measuring Crystal Frequency.....	34
R.F. Chokes, Winding Form.....	34	Mounting Filter Condensers.....	34
R.F. Control on SW3.....	11	Photronic Cell for Temperature Control.....	32
R.F. Indicators from Rectifier Tubes.....	34	Plug-In Transmitting Coils.....	19
R.F. Transformer, 5-prong Coil Forms.....	10	Preventing Filament Blinking.....	34
Radiation, Reducing Harmonic.....	71	Push-Pull Electron-Coupled Oscillators.....	22
Receiving Antennas.....	74	R.F. Chokes from Coils.....	34
Receiving Tube M.O.P.A. Transmitter.....	20	R.F. Indicators.....	34
Receivers:		Series Feed for Plate and Grid.....	20
A Converter for the Ultra-High Frequencies.....	17	Some By-Passing Pointers.....	23
A Hint for Reducing Noise Level.....	17	Switching the Plate Meter.....	33
A Single-Tube Converter.....	14	Time Delay Method.....	34
Accurate Calibration of a Receiver.....	15	Toroid R.F. Choke.....	34
Aluminum Pan Chassis.....	18	Transmitter Frame Enclosure.....	33
An Adapter for the SE-143.....	14	Vacuum Tube Relays for Thermostats.....	32
Audio Selectivity — Alias Tone Control.....	16	Winding Form for R.F. Chokes.....	34
Cleaner.....	18	Transmitting Antennas for Receiving.....	75
Curing Parallax.....	16	Transmitting Antennas, Indoor.....	69
		Tube Caps, Fixing.....	9
		Tube Keying Methods.....	57

	PAGE		PAGE
Tube Keying Simplified.....	56	Vacuum-Tube Bleeder Resistance.....	67
Tubes, Clearing Up Gas.....	34	Vacuum-Tube Bug.....	57
Tubing, Softening and Polishing Copper.....	9	Vacuum-Tube Relay.....	32
Tunable Hum, Cutting Out.....	10	Velocity Microphone, D.C. Field.....	35
Tuned Pick-Up.....	22	Velocity Microphone, Permanent Magnet.....	35
Two-Tube Detector.....	11	Voltage Feed System, Improved.....	70
Type '38 Screen-Grid Detector.....	12	Voltage Regulation.....	63
Ultra High Frequency Converter.....	17	Voltmeter, Multi-Range.....	6
Ultra High Frequency Interference with B.C.L.'s.....	62	Voltmeter, Use as Milliammeter.....	7
Untuned Line, Coupling to Zepp.....	72	Winding Machine for Spaced Turn Chokes.....	7

